Supplemental Filing

Response to Data Requests
16 and 55 through 72

In support of the

Petition for Amendment No. 1

for the

Russell City Energy Center

Hayward, California

(01-AFC-7C)

Submitted to the:

California Energy Commission

Submitted by:

Russell City Energy Company, LLC

With Technical Assistance by:

CH2MHILL

Sacramento, California

March 2007

Contents

Introduction

Attached are Russell City Energy Company, LLC's responses to California Energy Commission (CEC) Staff data requests numbers 16 and 55 through 72 for the Russell City Energy Center (RCEC) Petition for Amendment No. 1 (01-AFC-7C). The CEC Staff served Data Requests 55 through 72 on March 8, 2007, as part of the discovery process for the RCEC amendment petition. The responses are grouped by individual discipline or topic area. Within each discipline area, the responses are presented in the same order as CEC Staff presented them and are keyed to the Data Request numbers (1 through 72). New or revised graphics or tables are numbered in reference to the Data Request number. For example, the first table used in response to Data Request 15 would be numbered Table DR15-1. The first figure used in response to Data Request 28 would be Figure DR28-1, and so on.

Additional tables, figures, or documents submitted in response to a data request (supporting data, stand-alone documents such as plans, folding graphics, etc.) are found at the end of a discipline-specific section and are not sequentially page-numbered consistently with the remainder of the document, though they may have their own internal page numbering system.

Air Quality

Data Request Response 16

Air Quality (16)

Cumulative Impacts Analysis

16. *Please provide the cumulative impacts analysis or identify the timeline for completion and submittal of the cumulative impacts analysis.*

Response: Localized impacts from the Russell City Energy Center (RCEC) could result from emissions of carbon monoxide (CO), oxides of nitrogen (NOx), sulfur dioxide (SO_2), directly-emitted particulate matter less than 10 microns in diameter (PM_{10}), and directly-emitted particulate matter less than 2.5 microns in diameter ($PM_{2.5}$). A dispersion modeling analysis of potential cumulative air quality impacts was performed for SO_2, CO, NOx, PM_{10}, and $PM_{2.5}$. A cumulative multi-source modeling analysis was performed for the proposed RCEC emission sources, combined with emissions for the Eastshore Energy Center (Eastshore), a proposal to construct a new power plant energy near Industrial Boulevard in Hayward, California, approximately 0.5 miles east of the RCEC site. The BAAQMD has been contacted in order to provide information on other potential sources located within six (6) miles of RCEC. At this time, it is expected that if other sources exist within the six mile radius of RCEC, these sources would be insignificant. These sources will be included in a updated cumulative impact modeling assessment when the BAAQMD makes information about them available.

In evaluating the potential cumulative localized impacts, the proposed facility is modeled in conjunction with the impacts of existing facilities and facilities not yet in operation but that are reasonably foreseeable. At this time, modeling data for emission sources have not been finalized for projects other than Eastshore and RCEC. Projects that exist and have been in operation are reflected in the ambient air quality data that have been used to represent background concentrations; consequently, no further analysis of the emissions from this category of facilities will be performed. The cumulative multisource modeling analysis adds the modeled impacts of selected facilities to the maximum measured background air quality levels, thus ensuring that existing and proposed projects are taken into account.

Based on the results of the air quality modeling analyses described in the Amendment (Section 3.1, Air Quality), "significant" air quality impacts, as that term is defined in federal air quality modeling guidelines, have generally not been shown to occur for the RCEC. Significance is defined as the concentration levels at which a project impact could be measured. Typically, if the project's impacts do not exceed the significance levels, no cumulative impacts would be expected to occur, and no further analysis would be required under federal regulations. Notwithstanding this fact, a potential impact area in which cumulative localized impacts could be expected to occur has *typically* been identified as an area within a radius of 6 miles around the proposed site. Sources that are proposed but not yet operational located within this area (or within a search area with a radius of 6 miles beyond the project's significant impact area) are modeled in a multi-source modeling analysis. As described above, a multi-source modeling analysis has been prepared for proposed emissions from the RCEC and Eastshore facilities, which when combined, are expected to be the only two predominant sources in the area.

Given the potentially wide geographic area over which the dispersion modeling analysis may be performed, the ISCST3 model was used to evaluate cumulative localized air quality impacts for all pollutants other than the 1-hour nitrogen dioxide (NO_2) concentrations. For 1-hour NO_2 concentrations, impacts were evaluated with the ISCOLM model as was done for the facility-only analyses. The detailed modeling procedures, model options, and meteorological data used in the cumulative impacts dispersion analysis were the same as those used for the proposed facility as described in the AFC Air Quality section. In addition to the receptor grids used in the original RCEC modeling analysis, the 10-meter spaced downwash and fenceline receptor grids from the Eastshore modeling analysis were included. Since 24-hour $PM_{2.5}$ maximum multi-source impacts were predicted to occur in the coarse/intermediate grids, an additional 10-meter-spaced refined receptor grid was modeled for this pollutant and averaging time.

The dispersion modeling analysis of cumulative localized air quality impacts for the proposed project was evaluated in combination with the Eastshore Energy Center and air quality levels attributable to existing emission sources, and the impacts were compared to state or federal air quality standards to determine significance. The maximum modeled concentrations were used to demonstrate compliance with California ambient air quality standards (CAAQS) and Federal (USEPA) National ambient air quality standards (NAAQS).

Supporting information used in the analysis included the following:

- Each source's respective coordinate locations
- Stack parameters for sources included in the cumulative air quality impacts dispersion modeling analysis
- Output files for the dispersion modeling analysis

Stack locations and building dimensions used for downwash considerations were the same as the facility modeling analyses for both RCEC and Eastshore. Worst-case source conditions defined by the screening analyses in the facility modeling analyses for both RCEC and Eastshore were used to define stack conditions analyzed. For CO, worst-case impacts were shown in the RCEC modeling analyses to occur for RCEC start-up conditions (RCEC fire pump assumed not to run concurrently). All of these conditions are shown in Tables DR16-1 and DR16-2.

TABLE DR16-1
Stack Parameters and Emission Rates for RCEC Facility*

	Stack Height (meter)	Stack Diam. (meter)	Stack Temp (deg K)	Exhaust Velocity (m/s)	Emission Rates (g/s) for each turbine/HRSG and cooling tower cell			
					NOx	SO_2	CO	$PM_{10}/PM_{2.5}$
Averaging Period: 1-hour								
Turbines/HRSGs	44.196	5.4864	355.39	22.175	2.0379	0.7812	169.946	N/A
Fire Pump Diesel Engine	4.572	0.1524	665.37	53.340	0.3558	3.942E-4	N/A	N/A
Averaging Period: 3-hours								
Turbines/HRSGs	44.196	5.4864	355.39	22.175	N/A	0.7812	N/A	N/A
Fire Pump Diesel Engine	4.572	0.1524	665.37	53.340	N/A	1.314E-4	N/A	N/A
Averaging Period: 8-hours								
Turbines/HRSGs	44.196	5.4864	355.39	22.175	N/A	N/A	80.2353	N/A

TABLE DR16-1
Stack Parameters and Emission Rates for RCEC Facility*

	Stack Height (meter)	Stack Diam. (meter)	Stack Temp (deg K)	Exhaust Velocity (m/s)	Emission Rates (g/s) for each turbine/HRSG and cooling tower cell			
					NOx	SO_2	CO	$PM_{10}/PM_{2.5}$
Averaging Period: 24 hours								
Turbines/HRSGs	44.196	5.4864	350.68	14.075	N/A	0.4284	N/A	1.1340
Fire Pump Diesel Engine	4.572	0.1524	665.37	53.340	N/A	1.640E-5	N/A	4.167E-4
Cooling Tower	18.288	9.7536	298.17	10.308	N/A	N/A	N/A	0.0396
Averaging Period: Annual								
Turbines/HRSGs	44.196	5.4864	356.83	21.655	1.9350	0.1755	N/A	1.0742
Fire Pump Diesel Engine	4.572	0.1524	665.37	53.340	2.112E-3	2.339E-6	N/A	5.936E-5
Cooling Tower	18.288	9.7536	300.27	10.308	N/A	N/A	N/A	0.0387

*Annual averaging periods include startup/shutdown emissions, where applicable.
deg K = degree Kelvin, g/s = grams per second, m/s = meters per second

TABLE DR16-2
Stack Parameters and Emission Rates for Eastshore Facility*

	Stack Height (m)	Stack Diam (m)	Stack Temp (deg K)	Exhaust Velocity (m/s)	Emission Rates (g/s) for each Engine and Diesel Emer.Generator			
					NO_X	SO_2	CO	$PM_{10}/PM_{2.5}$
Averaging Period: 1-hour								
Engines (14)	21.336	1.208	628.71	22.42	1.2424	0.03024	1.8698	N/A
Black Start Diesel Engine	10.0	0.1778	735.37	41.02	0.226	4.79E-4	0.0270	N/A
Averaging Period: 3-hours								
Engines (14)	21.336	1.208	628.71	22.42	N/A	0.03024	N/A	N/A
Black Start Diesel Engine	10.0	0.1778	735.37	41.02	N/A	1.60E-4	N/A	N/A
Averaging Period: 8-hours								
Engines (14)	21.336	1.208	628.71	22.42	N/A	N/A	1.8698	N/A
Black Start Diesel Engine	10.0	0.1778	735.37	41.02	N/A	N/A	3.38E-3	N/A
Averaging Period: 24 hours								
Engines (14)	21.336	1.208	628.71	22.42	N/A	0.03024	N/A	0.284655
Black Start Diesel Engine	10.0	0.1778	735.37	41.02	N/A	2.0E-5	N/A	5.60E-4
Averaging Period: Annual								
Engines (14)	21.336	1.208	641.48	22.27	0.11535	1.395E-2	N/A	0.1474
Black Start Diesel Engine	10.0	0.1778	735.37	41.02	7.728E-4	1.640E-6	N/A	4.596E-5

*Annual averaging periods include startup/shutdown emissions, where applicable.
deg K = degree Kelvin, g/s = grams per second, m/s = meters per second

The proposed project was modeled with these sources in the cumulative multisource analysis to determine maximum concentrations. The maximum background concentrations were then added to this total and compared to CAAQS and NAAQS. Table DR16-3 below summarizes the results of the cumulative modeling analysis.

TABLE DR16-3
Cumulative Impacts Modeling Results (µg/m3)

Pollutant	Averaging Time	Maximum Multisource Concentration (µg/m^3)	Background (µg/m^3)	Total Ambient Concentration (µg/m^3)	State Standard (µg/m^3)	Federal Standard (µg/m^3)
NO_2	1-hour	226.83	143.0	369.83	470	-
	Annual	0.64	32.0	32.64	-	100
SO_2	1-hour	7.33	102.2	109.53	655	-
	3-hour	6.61	49.4	56.01	1300	1300
	24-hour	4.87	23.5	28.37	105	365
	Annual	0.075	8.0	8.075		80
CO	1-hour	1199.88	3680.0	4879.88	23,000	40,000
	8-hour	222.63	2178.0	2400.63	10,000	10,000
PM_{10}	24-hour	8.29	51.7	59.99	50	150
	Annual	0.81	18.1	18.91	20	50
$PM_{2.5}$	24-hour	4.36	37	41.36	-	65
	Annual	0.81	9.4	10.21	12	15

Modeled and Background $PM_{2.5}$ 24-hour averages, for comparison to the federal standard, are the maximum 3-year average of the annual 98th percentile 24-hour concentrations (i.e., for modeled impacts equal to the 8th highest concentration at each receptor).

As can be seen, maximum modeled concentrations are less than the CAAQS and NAAQS for all pollutants and all averaging times. Maximum ambient (modeled plus background) concentrations are greater than the CAAQS for 24-hour and annual PM_{10}. Maximum ambient (modeled plus background concentrations) are greater than the CAAQS and NAAQS for annual $PM_{2.5}$. Maximum ambient (modeled plus background) concentrations for all other pollutants and averaging times are less than the CAAQS and NAAQS.

Maximum ambient (modeled plus background) concentrations exceed the applicable PM_{10} and $PM_{2.5}$ CAAQS/NAAQS because the background concentrations already are very nearly equal to or exceed the applicable standards (e.g., there were no modeled PM_{10} or $PM_{2.5}$ concentrations without background greater than the CAAQS or NAAQS). The project is located in a state non-attainment area for $PM_{2.5}$ and PM_{10}. Since the modeled multisource impacts by themselves, without considering background, are less than the PM_{10} or $PM_{2.5}$ ambient air quality standards, the projects do not cause or contribute to the regional non-attainment status because the projects are located in a state non-attainment areas and will mitigate the modeled exceedances to a level of insignificance.

Alternatives

Data Request Responses 55-56

Alternatives (55-56)

Alternative Site E (West Winton Avenue)

55. *Please compare the currently proposed site to Alternative Site E with regard to aviation safety and consistency with the Hayward Airport Approach Zoning Plan (HMC §10-6.35).*

Response: The proposed RCEC site would not cause a hazard to air navigation and would not "endanger the landing, take-off, or maneuvering of aircraft." The RCEC is located more than 1.5 miles from the nearest point of the nearest runway and is not located along or underneath any of the recognized approach patterns for airport landing or takeoff. The proposed RCEC structures also would not penetrate any of the Federal Aviation Administration's (FAA's) "imaginary surfaces" that define the protected airspace near a public airport, including the approach surface, transitional surface, or horizontal surface.

The City of Hayward's Airport Master Plan for Hayward Executive Airport (City of Hayward 2002) defines the airport's Traffic Pattern Zone, which extends about one mile from the airport runways and is the zone within which aircraft fly when circling the airport (See Hayward Executive Airport Master Plan, Exhibit 5B, Figure DR55-1). RCEC is outside of and about one half-mile southwest of this boundary.

The Hayward Airport Master Plan also mandates certain flight pathways for aircraft to follow for residential zone noise abatement. Aircraft taking off from the airport must follow certain clearly defined patterns to avoid flying over residential areas at low altitude. Neither the Preferred Departure Paths, Touch-n-go Traffic Pattern, or Helicopter Operations paths fly over the RCEC site or come any nearer than one half-mile from the RCEC site (Hayward Executive Airport Master Plan, Exhibit 1C, Figure DR55-2). In addition, the Pattern Altitude (the altitude at which aircraft are required to fly when circling the runway for landing approach) is 600 feet for Runway 28L-10R and 800 feet for Runway 28R-10L. The tallest RCEC structure (HRSG stacks) would be 145 feet high.

Neither would hot air exhaust plumes from the RCEC's stacks cause a hazard to air navigation. The FAA recently conducted a study to assess the risk of aircraft flying over industrial exhaust plumes (FAA 2006), included here as Attachment DR55-1 and titled "Safety Risk Analysis of Aircraft Overflight of Industrial Exhaust Plumes." This study examined the available databases of pilot reports and accident/incident reports over a thirty-year period. These data included more than 670,000 pilot reports and more than 150,000 accident/incident records. The study's authors determined that there were no accidents due to or involving industrial exhaust plumes and only one, unconfirmed, incident during this time. The study determined that the risk of accident would be one in a billion, two orders of magnitude below the FAA's safety standard of one in 10 million. The report concluded that the risk would be "extremely low" and that "*the risk associated with plumes is deemed acceptable without restriction, limitation, or further mitigation* (italics added)." The report also states:

> Current regulations and advisories as well as the present Notice to Airmen (NOTAM) Temporary Flight Restrictions should preclude prudent pilots

from flying through or near plumes, thereby making the aviation risk essentially zero (FAA 2006, p. 16, Conclusion 2).

Thermal plumes are discussed further in this document in responses to Data Requests 66 through 68.

Alternative Site E, located on West Winton Avenue at the Pick-Your-Part Automobile Salvage Yard is approximately 0.75 miles from the nearest point on a Hayward Executive Airport runway. As such, it is located within the one-mile Traffic Pattern Zone of the airport. There are no other significant differences between Site E and the existing RCEC site in terms of aviation safety. Neither site would pose a hazard to air navigation.

References Cited:

City of Hayward. 2002. Hayward Executive Airport, Airport Master Plan. City of Hayward. http://www.hayward-ca.gov/departments/publicworks/documents/airport/masterplan.pdf

FAA. 2006. *Safety Risk Analysis of Aircraft Overflight of Industrial Exhaust Plumes.* Federal Aviation Administration Safety Study Report DOT-FAA-AFS-420-06-1. FAA Flight Standards Branch, Oklahoma City, Oklahoma. By Gary L. Powell, Alan B. Jones, Mark A. Reisweber, Lt. Col. Paul McCarver USAF, Dr. James H. Yates, and John Holman.

Alternative Sites A, B, C (Newark-Cargill, Fremont-Stevenson, Fremont-Boyce)

56. Please discuss whether Alternative Site A (Newark-Cargill) in the City of Newark, and Alternative sites B (Fremont-Stevenson) and C (Fremont-Boyce) in the City of Fremont are within the airspace of any airport and whether their use could present potential aviation safety hazards.

Response: None of these three sites are within the airspace of any airport. As with the RCEC site and Hayward-West Winton site, none of these alternative sites would present potential safety hazards.

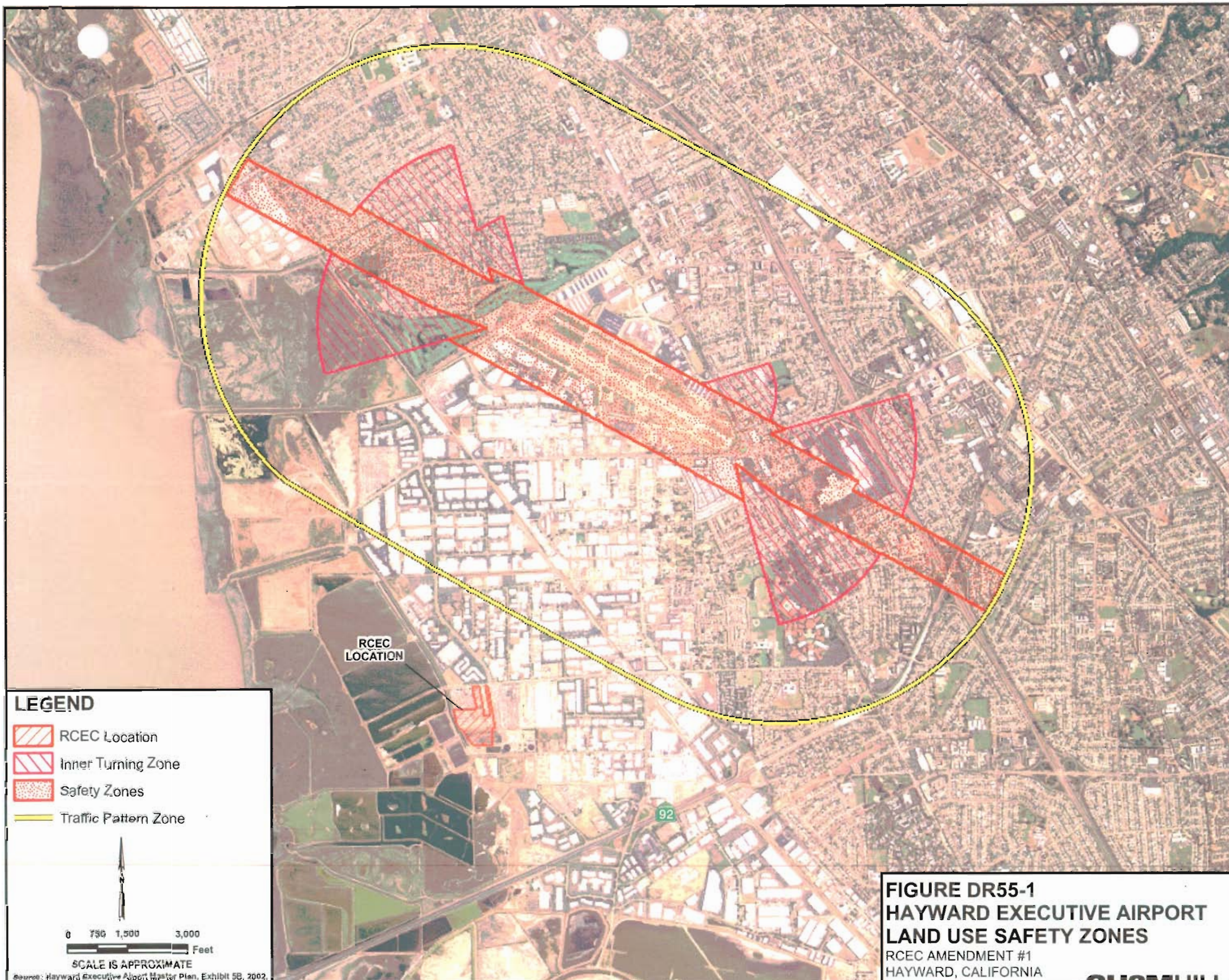

FIGURE DR55-1
HAYWARD EXECUTIVE AIRPORT
LAND USE SAFETY ZONES
RCEC AMENDMENT #1
HAYWARD, CALIFORNIA

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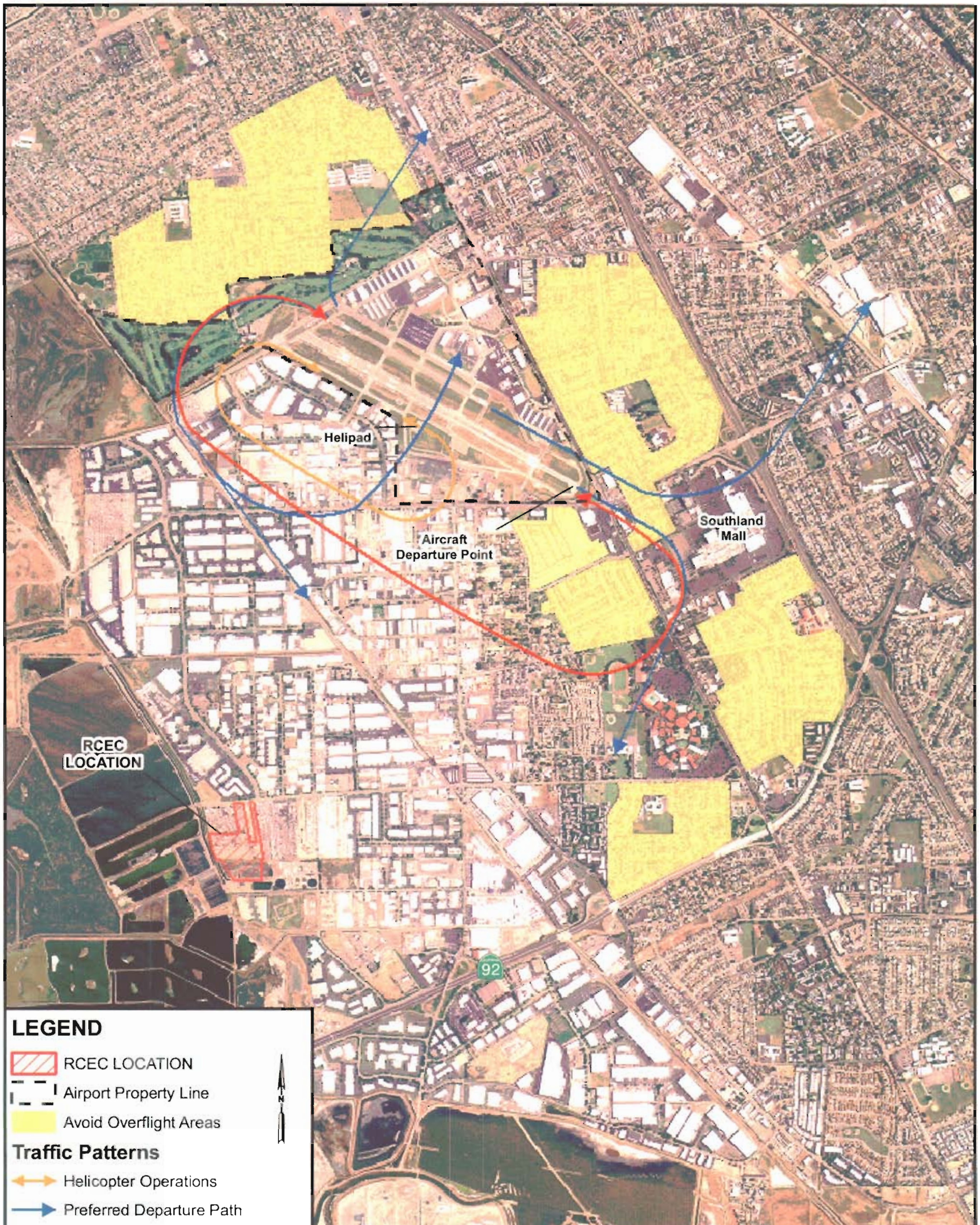

FIGURE DR55-2
HAYWARD EXECUTIVE AIRPORT NOISE ABATEMENT FLIGHT PROCEDURES
RCEC AMENDMENT #1
HAYWARD, CALIFORNIA

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Attachment DR55-1

FAA Safety Study Report DOT-FAA-AFS-420-06-01

Admin Notice 1a.

Safety Study Report
DOT-FAA-AFS-420-06-1

Safety Risk Analysis of Aircraft Overflight of Industrial Exhaust Plumes

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1. Report No. DOT-FAA-AFS-420-06-1	2. Government Accession No.	3. Recipient's Catalog No.
4. Title and Subtitle Safety Risk Analysis of Aircraft Overflight of Industrial Exhaust Plumes		5. Report Date January 2006
6. Author(s) Gary L. Powell, Mark A. Reisweber, Dr James Yates, Alan B. Jones, Paul McCarver, John Holman		7. Performing Organization Code
8. Performing Organization Name and Address Flight Procedure Standards Branch, AFS-420 6425 S. Denning, Room 104 Oklahoma City, Oklahoma 73169		9. Type of Report and Period Covered Safety Study
10. Sponsoring Agency Name and Address Federal Aviation Administration Mike Monroney Aeronautical Center P.O. Box 25082, Oklahoma City, OK 73125		
11. Supplementary Notes		

12. Abstract

The Flight Procedures Standards Branch (AFS-420), Flight Technologies and Procedures Division (AFS-400), was tasked by the Director of Flight Standards Service (AFS-1) of the Federal Aviation Administration (FAA) to perform a risk analysis of overflights of vertical plumes. These thermal "*plumes,*" visible or invisible, are generally associated with exhaust from the smoke stacks of power generating facilities, industrial production facilities, or other systems which could have the ability to release large amounts of pressurized or otherwise unstable air. AFS-420 organized and led a safety risk analysis team consisting of FAA subject matter experts (SME) and civilian contract personnel. The SME from various disciplines including: aviation safety, risk analysis/assessment, human factors, aeronautical engineering, air traffic control (ATC), statistical analysis, military/civil and commercial aviation each provided a high level of experience and expertise to examine the issue. Team members are identified in Appendix A. The team determined that the FAA Safety Risk Management (SRM) methodology contained in the FAA Safety Management System (SMS) Manual would be an appropriate vehicle to perform their analysis. The underlying presumption is that high efflux temperature or velocity from industrial facilities may cause air disturbances via exhaust plumes. Two hazards were identified during brainstorming sessions by members of the safety risk analysis team. The first hazard recognized turbulence that may be associated with plumes that could result in possible airframe damage and/or negative affects on aircraft stability in flight. The second hazard discussed was the possible adverse effects of high levels of water vapor, engine/aircraft contaminants, icing, and restricted visibilities produced by these plumes. These hazards taken individually or cumulatively, could possibly result in the loss of the aircraft or fatal injury to the crew, as well as substantial damage to ground facilities. The SME team considered these situations to be most critical for general aviation (GA) aircraft flying at low altitudes during the takeoff and/or landing phase when an aircraft is in close proximity to an airport. The safety risk analysis team performed their analysis of the predictive risks associated with the plumes and determined the effects of the hazards as low, or in the green section of the risk matrix. As a result of this assessment, the risk associated with plumes is deemed acceptable without restriction, limitation, or further mitigation. However, to further lower the already acceptable risk associated with the overflight of vertical plumes, the team recommended the continuance of training and awareness programs that have been successful with similar hazards of acceptable risk levels.

13. Key Words	14. Distribution Statement
Plumes, Smoke Stacks , Aircraft overflight of industrial exhaust plumes, Powerplants, Power generating facilities	Controlled by AFS-420
15. Security Classification of This Report Unclassified	16. Security Classification of This Page Unclassified

Executive Summary

The Flight Procedures Standards Branch (AFS-420), Flight Technologies and Procedures Division (AFS-400), was tasked by the Director of Flight Standards Service (AFS-1) of the Federal Aviation Administration (FAA) to perform a risk analysis of overflights of vertical exhaust plumes. These thermal *"plumes,"* visible or invisible, are generally associated with exhaust from the smoke stacks of power generating facilities, industrial production facilities, or other systems which could have the ability to release large amounts of pressurized or otherwise unstable air.

AFS-420 organized and led a safety risk analysis team consisting of FAA subject matter experts (SME) and civilian contract personnel. The SME from various disciplines including: aviation safety, risk analysis/assessment, human factors, aeronautical engineering, air traffic control (ATC), statistical analysis, and military/civil and commercial aviation, each provided a high level of experience and expertise to examine the issue. Team members are identified in Appendix A. The team determined that the FAA Safety Risk Management (SRM) methodology contained in the FAA Safety Management System (SMS) Manual would be an appropriate vehicle to perform their analysis.

The underlying presumption is that high efflux temperature or velocity from industrial facilities may cause air disturbances via exhaust plumes. Two hazards were identified by members of the safety risk analysis team. The first hazard recognized turbulence that may be associated with plumes that could result in possible airframe damage and/or negative effects on aircraft stability in flight. The second hazard discussed was the possible adverse effects of high levels of water vapor, engine/aircraft contaminants, icing, and restricted visibilities produced by these plumes. These hazards, taken individually or cumulatively, could possibly result in the loss of the aircraft or fatal injury to the crew, as well as substantial damage to ground facilities. The SME team considered these situations to be most critical for general aviation (GA) aircraft flying at low altitudes during the takeoff and/or landing phase when an aircraft is in close proximity to an airport.

The tools and analysis techniques that were used to review the hazards were the "What if" Technique and Preliminary Hazard Analysis (PHA). These tools are described in-depth in the *SMS Manual*. The SRM methodology used by the team to assess and identify safety hazards was to apply SME knowledge, experience, and expertise across the various disciplines during formal and informal review sessions.

The data sources which the team used to assess risks associated with the plume issue included: Aviation Safety Reporting System (ASRS), National Aviation Safety Data Analysis Center (NASDAC), Accident/Incident Data System (AIDS), National Transportation Safety Board (NTSB), Aviation Database & Synopses, and the

Australian Government Civil Aviation Safety Authority Advisory Circular (AC) 139-05(0) Guidelines for Conducting Plume Rise Assessments dated June 2004.

The analysis also included a review of a broad spectrum of the available safety data, regulations, and professional literature. The SME team also considered input from private citizens who had previously expressed concern with regard to the issue.

Historical statistical data analysis concluded that the accident/incident rate for overflights of exhaust plumes to be of the order of 10^{-9} or less. Since the target level of safety (TLS) for GA activities was determined to be 1×10^{-7}, the probability of an accident or incident from overflight of an exhaust plume is considerably less than the required TLS. Since the TLS is satisfied, the likelihood of an accident or incident caused by overflight of an exhaust plume is acceptably small.

The safety risk analysis team performed their analysis of the predictive risks associated with the plumes and determined the effects of the hazards as low, or in the green section of the risk matrix. As a result of this assessment, the risk associated with plumes is deemed acceptable without restriction, limitation, or further mitigation.

However, to further lower the already acceptable risk associated with the overflight of vertical plumes, the team recommended the continuance of training and awareness programs that have been successful with similar hazards of acceptable risk levels. The safety risk assessment team recommended the following:

- Amend the Aeronautical Information Manual (AIM) Chapter 7, Section 5 with wording to the effect that overflight at less than 1,000 feet vertically above plume generating industrial sites should be avoided.

- Publish (as appropriate) the position and nature of the present power plants located near public airports in the Airport/Facility Directory (A/FD) and issue a Notice to Airmen (NOTAM) when operationally necessary.

- Where operationally feasible, make the temporary fight restriction (TFR) that includes the overflight of power plants a permanent flight restriction.

- Amend FAA Order 7400.2 to consider a plume generating facility as a hazard to navigation when expected flight paths pass less than 1,000 feet above the top of the object. Flight Standards Service will be required to provide comment for any facility not meeting this criterion.

- Amend Advisory Circular 70/7460-2K Proposed Construction of Objects that May Affect the Navigable Airspace - Change Instructions for Completing FAA Form 7460-1 – Notice of Proposed Construction or Alteration Item # 21, add:

"For structures such as power plants or any industrial facility where exhaust plume discharge could reasonably be expected and reportable under the provisions of Part 77, thoroughly explain the nature of the discharge."

These actions will serve to further enhance aviation safety within the National Airspace System.

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1.0. Introduction

The Flight Procedures Standards Branch (AFS-420), Flight Technologies and Procedures Division (AFS-400), was tasked by the Director of Flight Standards Service (AFS-1) of the Federal Aviation Administration (FAA) to perform a risk analysis of overflights of vertical plumes. AFS-420 organized and led a safety risk analysis team (hereafter referred to as the "team") consisting of FAA subject matter experts (SME). Please see Appendix A for a list of SME team participants. The SME from various disciplines including aviation safety, risk analysis/assessment, human factors, aeronautical engineering, air traffic control (ATC), statistical analysis, and military/civil and commercial aviation provided a high level of experience and expertise to examine the issue. The team determined that the FAA Safety Risk Management (SRM) methodology contained in the FAA Safety Management System (SMS) Manual would be an appropriate vehicle to perform their analysis. This methodology includes the following:

- Description of the presumed safety issue
- Identification of potential hazards
- Risk Analysis
- Risk Assessment
- Treatment (mitigation) of the risk, if required

Note: The SRM process is usually applied for risk analysis/assessment of changes to baseline (current) facilities or procedures within the (NAS). However, AFS-420 personnel determined the SRM procedural process provided the greatest flexibility and broadest analysis for determining aviation risk for the issue at hand.

<u>Section 1</u> - **Description of the Presumed Safety Issue**

The underlying presumption is that high efflux temperature or velocity from industrial facilities may cause air disturbances via exhaust plumes that would have the potential to cause airframe damage and/or negatively affect the stability of aircraft in flight. Associated hazards could include: high levels of water vapor, icing, restricted visibilities, engine/aircraft contaminants. These hazards taken individually or cumulatively, could possibly result in the loss of the aircraft or fatal injury to the crew, as well as substantial damage to ground facilities. The team considered these situations to be most critical for general aviation (GA) aircraft flying at low altitudes during the takeoff and/or landing phase when an aircraft is in close proximity to an airport. These thermal *"plumes,"* visible or invisible, are generally associated with exhaust from the smoke stacks of power generating facilities, industrial production facilities, or other systems which could have the ability to release large amounts of pressurized or otherwise unstable air. Research has been accomplished by the Australian Government Civil Aviation Safety Authority (CASA) on plume rise velocities versus aircraft upset. The United States Environmental Protection Agency (EPA) plume rise models are, for the most part, models of plume dispersion and heat/velocity measures that do not provide any analysis on the effect of aircraft overflight.

Section 2 - Review of Safety Data/Literature and Identification of Potential Hazards

The review of safety data and associated literature obtained from various sources included the following:

- National Aeronautics and Space Administration (NASA), Aviation Safety Reporting System (ASRS)
- Federal Aviation Administration (FAA), National Aviation Safety Data Analysis Center (NASDAC), Accident/Incident Data System (AIDS)
- National Transportation Safety Board (NTSB) Aviation Database & Synopses
- Aeronautical Information Manual (AIM), Change 3, August 4, 2005
- Title 14 Code of Federal Regulations (CFR) with specific attention to: Part(s) 77 - *Objects Affecting the Navigable Airspace,* Part 91.13 - *Careless or Reckless Operation,* and Part 91.119 - *Minimum Safe Altitudes: General*
- Federal Aviation Administration Safety Management System Manual, Version 1.1, May 21, 2004
- Australian Government Civil Aviation Safety Authority Advisory Circular (AC) 139-05(0, Guidelines for Conducting Plume Rise Assessments dated June 2004 was reviewed. (Note: this information was used as professional reference material as the FAA does not necessarily agree or disagree with the guidance contained in the AC)

2.0. Discussion

The salient points discussed during the SMS brainstorming sessions at AFS-420 in Oklahoma City, Oklahoma, by the risk analysis team included, but were not limited to:

(1) Aviation Database Queries Regarding Overflight of Vertical Plumes

A database search of NASA ASRS records using various key words such as: *plumes, power plants, smoke stacks, nuclear, industrial power plants, power plant - aircraft – turbulence, smokestack(s), updrafts, downdrafts* and similar combinations was conducted and reviewed. The results of over 671,006 NASA ASRS pilot reports gathered over 30 a year period indicated zero pilot-reported overflight incidents with exhaust plumes from facilities such as power plants.

A similar search of the NASDAC AIDS (FAA) accident/incident database records search (approximately 150,000 records) indicated no accidents and one possible, yet not confirmed, helicopter incident in 1979. Additionally, there was one incident where a flight instructor claimed that outflow from a nearby power plant smoke stack may have contributed to an accident on May 19, 2000 at the Space Coast Regional Airport in Titusville, Florida. The NTSB concluded to the contrary, citing..."*failure of the PIC (pilot-in command) to maintain control of the aircraft...*" was the probable cause.

**Note: The aforementioned databases are open to the public and similar search requests may be accessed/queried via the Internet at: http://asrs.arc.nasa.gov and http://www.nasdac.faa.gov.

(2) FAA Regulations, Orders /Notices, and Guidelines

Additionally, the FAA has knowledge of two undocumented instances where pilots of aircraft *intentionally* flew through plumes of an electrical generating power plant and experienced predicable turbulence issues, where intensity varied directly with altitude. Since the pilots were not trained in methods of data collection and the aircraft were not equipped for data collection, no creditable data were collected. Therefore, these intentional incidents were not given further consideration and deemed irrelevant to the analysis.

The team felt it significant to note that the present Notice to Airmen (NOTAM) Temporary Flight Restrictions (TFR), active at the time of the above incidents, should have precluded prudent pilots from flying through or near plumes. Primarily issued for national security reasons, the TFR is listed as follows:

> **FDC 4/0811 FDC ...SPECIAL NOTICE... THIS IS A RESTATEMENT OF A PREVIOUSLY ISSUED ADVISORY NOTICE. IN THE INTEREST OF NATIONAL SECURITY AND TO THE EXTENT PRACTICABLE, PILOTS ARE STRONGLY ADVISED TO AVOID THE AIRSPACE ABOVE, OR IN PROXIMITY TO SUCH SITES AS POWER PLANTS (NUCLEAR, HYDRO-ELECTRIC, OR COAL), DAMS, REFINERIES, INDUSTRIAL COMPLEXES, MILITARY FACILITIES, AND OTHER SIMILAR FACILITIES. PILOTS SHOULD NOT CIRCLE AS TO LOITER IN THE VICINITY OVER THESE TYPES OF FACILITIES.**

The Aeronautical Information Manual (AIM) Chapter 7, addresses Potential Flight Hazards. Section 7-5-1, which discusses the 10 most frequent cause factors for General Aviation that involve the pilot-in-command, include the following:

5. Failure to see and avoid objects or obstructions, and

7. Improper in-flight decisions or planning.

We reviewed this section for information and methods for assessment and mitigation of similar flight hazards within the NAS that are addressed later in this study.

AIM Section 7-5-3 states:

Obstructions To Flight

a. General. Many structures exist that could significantly affect the safety of your flight when operating below 500 feet AGL, and particularly below

200 feet AGL. While 14 CFR Part 91.119 allows flight below 500 AGL when over sparsely populated areas or open water, such operations are very dangerous.

At and below 200 feet AGL there are numerous power lines, antenna towers, etc., that are not marked and lighted as obstructions, and therefore may not be seen in time to avoid a collision. Notices to Airmen (NOTAMs) are issued on those lighted structures experiencing temporary light outages. However, some time may pass before the FAA is notified of these outages, and the NOTAM issued, thus pilot vigilance is imperative.

b. Antenna Towers. Extreme caution should be exercised when flying less than 2,000 feet AGL because of numerous skeletal structures, such as radio and television antenna towers, that exceed 1,000 feet AGL, with some extending higher than 2,000 feet AGL. Most skeletal structures are supported by guy wires that are very difficult to see in good weather and can be invisible at dusk or during periods of reduced visibility. These wires can extend about 1,500 feet horizontally from a structure; therefore, all skeletal structures should be avoided horizontally by at least 2,000 feet. Additionally, new towers may not be depicted in a current aeronautical chart because the information was not received prior to the printing of the chart.

c. Overhead Wires. Overhead transmission and utility lines often span approaches to runways, natural flyways such as lakes, rivers, gorges, and canyons, and cross other landmarks pilots frequently follow such as highways, railroad tracks, etc. As with antenna towers, these high voltage/power lines or the supporting structures of these lines may not always be readily visible and the wires may be virtually impossible to see under certain conditions. In some locations, the supporting structures of overhead transmission lines are equipped with unique sequence flashing white strobe light systems to indicate that there are wires between the structures.

However, many power lines do not require notice to the FAA and, therefore, are not marked and/or lighted. Many of those that do require notice do not exceed 200 feet AGL or meet the Obstruction Standard of 14 CFR Part 77 and, therefore, are not marked and/or lighted. All pilots are cautioned to remain extremely vigilant for these power lines or their supporting structures when following natural flyways or during the approach and landing phase. This is particularly important for seaplane and/or float equipped aircraft when landing on, or departing from, unfamiliar lakes or rivers.

d. Other Objects/Structures. There are other objects or structures that could adversely affect your flight such as construction cranes near an airport, newly constructed buildings, new towers, etc. Many of these structures do not meet charting requirements or may not be charted because of the charting cycle.

Some structures do not require obstruction marking and/or lighting and some may not be marked and lighted even though the FAA recommended it.

Title 14 Code of Federal Regulations (CFR) Part 91 provides the following guidance for minimum safe flight altitudes and defines careless or reckless operation. We mention these two sections, as they will become significant to the scope of our investigation.

These rules apply to all aircraft operated under 14 CFR Parts 91, 121, 135 or 137.

Sec. 91.119

Minimum safe altitudes: General

Except when necessary for takeoff or landing, no person may operate an aircraft below the following altitudes:

(a) *Anywhere.* An altitude allowing, if a power unit fails, an emergency landing without undue hazard to persons or property on the surface.

(b) *Over congested areas.* Over any congested area of a city, town, or settlement, or over any open air assembly of persons, an altitude of 1,000 feet above the highest obstacle within a horizontal radius of 2,000 feet of the aircraft.

(c) *Over other than congested areas.* An altitude of 500 feet above the surface, except over open water or sparsely populated areas. In those cases, the aircraft may not be operated closer than 500 feet to any person, vessel, vehicle, or structure.

(d) *Helicopters.* Helicopters may be operated at less than the minimums prescribed in paragraph (b) or (c) of this section if the operation is conducted without hazard to persons or property on the surface. In addition, each person operating a helicopter shall comply with any routes or altitudes specifically prescribed for helicopters by the Administrator.

Sec. 91.13

Careless or reckless operation.

(a) *Aircraft operations for the purpose of air navigation.* No person may operate an aircraft in a careless or reckless manner as to endanger the life or property of another.

(b) *Aircraft operations other than for the purpose of air navigation.* No person may operate an aircraft, other than for the purpose of air navigation, on any part of the surface of an airport used by aircraft for air commerce (including areas used by those aircraft for receiving or discharging persons or cargo), in a careless or reckless manner as to endanger the life or property of another.

(3) Other Related Material

The Australian Government Civil Aviation Safety Authority (CASA) Advisory Circular (AC) 139-05(0), Guidelines for Conducting Plume Rise Assessments of June 2004, was reviewed as guidance to illustrate a means, but not necessarily the only means of assessing ... *"the potential hazard from plume rise to aircraft operations."* The AC further finds...

- *"Aviation authorities have established that an exhaust plume with a vertical gust in excess of 4.3 meters/second (m/s) may cause damage to an aircraft airframe, or upset an aircraft when flying at low levels."*
- "CASA requires the proponent of a *facility with an exhaust plume, which has a vertical velocity exceeding the limiting value (4.3 m/s at the aerodrome Obstacle Limitation Surface (OLS) or at 110 meters above the ground level anywhere else) to be assessed for potential hazard to aircraft operation.*"

The FAA does not necessarily approve/disapprove or warrant the data contained in the CASA AC 139-05. The team accepts the information and data contained in AC 139-05 as a valid representation of hazardous exhaust velocities. Lacking other professional data to the contrary, the team used the CASA AC information during the risk assessment and analysis process by stipulating the measures of efflux velocities and altitudes are plausible/representative aviation community data.

However, many narrative sections of AC 139-05 do not apply as Australian laws and regulations regarding land use, hazard assessments, and procedures regarding objects affecting the navigable airspace are far different from those of the United States. A prime example of this is in paragraph 6.2 of the AC where CASA states an obstacle "*...can include the gaseous efflux, which is capable of physical definition or measurement.*" In the United States, 14 CFR Part 77 only considers the height of the structure. For these and similar reasons only quantifiable metrics of plume data will be referenced.

Statement on scope of analysis:

The tools and analysis techniques that were used to analyze the hazards were the "What if" Technique and Preliminary Hazard Analysis (PHA). These tools are described in-depth in the *SMS Manual.* The SRM methodology used by the team to assess and identify safety hazards applied SME knowledge, experience, and expertise across the various disciplines during formal and informal "brainstorming" sessions. The risk analysis team determined the greatest risk of overflight of vertical plumes to aircraft would be in the takeoff and approach/landing phase of flight. Therefore, the analysis would concentrate on these low low-level flying activities (below 1,000 feet AGL). Here, the aircraft would be in close proximity to the ground, and smoke stack/plumes and any resultant turbulence or associated risk would be of greatest consequence.

Therefore, the 4.3 m/s velocity and/or the 110 meters (approximately 360.89 feet) height above the stack CASA criteria for assessment would be most critical during the takeoff/landing phase of flight as the aircraft would be at higher altitudes during other phases, i.e., climb, enroute, and arrival.

The risk analysis team identified the following hazards:

Hazard H1 was identified by association of plumes with other convective activity such as: updrafts, downdrafts, forest fires, and/or weather related activity, and under AIM guidance Obstructions to Flight – Other Objects/Structures.

H1: High efflux temperature or velocity from industrial facilities (power plant exhaust plumes) may cause air disturbances that would have the potential to cause airframe damage and/or negatively affect the stability of aircraft in-flight.

These situations would be most critical at low altitude during the takeoff and/or landing phase when an aircraft is in close proximity to an airport and could possibly result in loss of both aircraft and crew as well as damage to ground facilities.

Hazard H2 was identified by correspondence of concerned citizens and discussion with pilots and ATC personnel.

H2: Exhaust plumes from industrial facilities (power plant, gas or coal fired furnaces, etc.) could result in restricted visibilities with high levels of water vapor, icing, and engine/aircraft contaminants that would have a detrimental effect on aircraft/aircrew performance. These individually or cumulatively could possibly result in substantial aircraft damage, and/or loss of both aircraft and crew as well as damage to ground facilities. These situations would be most critical at low altitude during the takeoff and/or landing phase when an aircraft is in close proximity to an airport.

Section 3 - Risk Analysis and Risk Assessment

Statistical Analysis of Data

In attempting to derive a target level of safety for overflight of exhaust plumes, one difficulty (although most welcome) is that accidents and incidents have been non-existent, so the basis of historical data is limited. The procedure adopted here is to derive target levels of safety for an accident and for a fatal accident due to all causes, and then to estimate what proportion of that risk to allocate to overflight of exhaust plumes. To assess the overall risk, two separate stages are involved as follows:

a) The choice of a unit for the measurement of risk.

b) The choice of a target level for the total risk due to all causes.

A target level of safety for civil aviation may be specified in a number of ways. The most common unit is the fatal accident per departure. In the case of scheduled air carrier operations, the number of departures is recorded annually and the determination of fatal accidents per departure is straightforward. In the case of general aviation, the flights are unscheduled and unrecorded making any estimate of the number of departures extremely inaccurate. However, the FAA conducts an annual survey of general aviation pilots to determine an estimate of the number of hours flown by general aviation pilots during the year in question. Since the survey is scientifically constructed and conducted, the data should be reasonably accurate. Therefore, the decision was made to use incidents per flight hour and fatal accidents per flight hour as the units in the development of the target level of safety.

Table 1 lists the number of accidents, fatal accidents, estimated hours flown, and accident rates for the years 1975 through 2004.

Table 1 - Accidents, Fatalities, Flight Hours, and Rates, 1975 through 2004, U.S. General Aviation

	Accidents		Fatalities			Accidents per 100,000 Flight Hours	
Year	**All**	**Fatal**	**Total**	**Aboard**	**Flight Hours**	**All**	**Fatal**
1975	3995	633	1252	1231	28,799,000	13.87	2.19
1976	4018	658	1216	1203	30,476,000	13.17	2.16
1977	4079	661	1276	1265	31,578,000	12.91	2.09
1978	4216	719	1556	1398	34,887,000	12.08	2.06
1979	3818	631	1221	1203	38,641,000	9.88	1.63
1980	3590	618	1239	1230	36,402,000	9.86	1.69
1981	3500	654	1282	1261	36,803,000	9.51	1.78
1982	3,233	591	1187	1171	29,640,000	10.82	1.96
1983	3,075	555	1,068	1,061	28,673,000	10.67	1.92
1984	3,017	545	1,042	1,021	29,099,000	10.28	1.84
1985	2,739	498	956	945	28,322,000	9.63	1.74
1986	2,581	474	967	879	27,073,000	9.49	1.73
1987	2,495	446	837	822	26,972,000	9.18	1.63
1988	2,388	460	797	792	27,446,000	8.65	1.66
1989	2,242	432	769	766	27,920,000	7.97	1.52
1990	2,242	444	770	765	28,510,000	7.85	1.55
1991	2,197	439	800	786	27,678,000	7.91	1.57
1992	2,111	451	867	865	24,780,000	8.51	1.82
1993	2,064	401	744	740	22,796,000	9.03	1.74
1994	2,022	404	730	723	22,235,000	9.08	1.81
1995	2,056	413	735	728	24,906,000	8.21	1.63
1996	1,908	361	636	619	24,881,000	7.65	1.45
1997	1,844	350	631	625	25,591,000	7.19	1.36
1998	1,905	365	625	619	25,518,000	7.44	1.41
1999	1,905	340	619	615	29,246,000	6.5	1.16
2000	1,837	345	596	585	27,838,000	6.57	1.21
2001	1,727	325	562	558	25,431,000	6.78	1.27
2002	1,715	345	581	575	25,545,000	6.69	1.33
2003	1,741	352	632	629	25,705,000	6.77	1.37
2004	1,614	312	556	556	25,900,000	6.22	1.2
Totals	77,874	14,222	26,749	26,236	849,291,000		
Means	2595.8	474.0667	891.6333	874.5333	28,309,700	9.012333	1.649333

From Table 1, we see that the accident rate trend has been downward. This is illustrated in Figure 1.

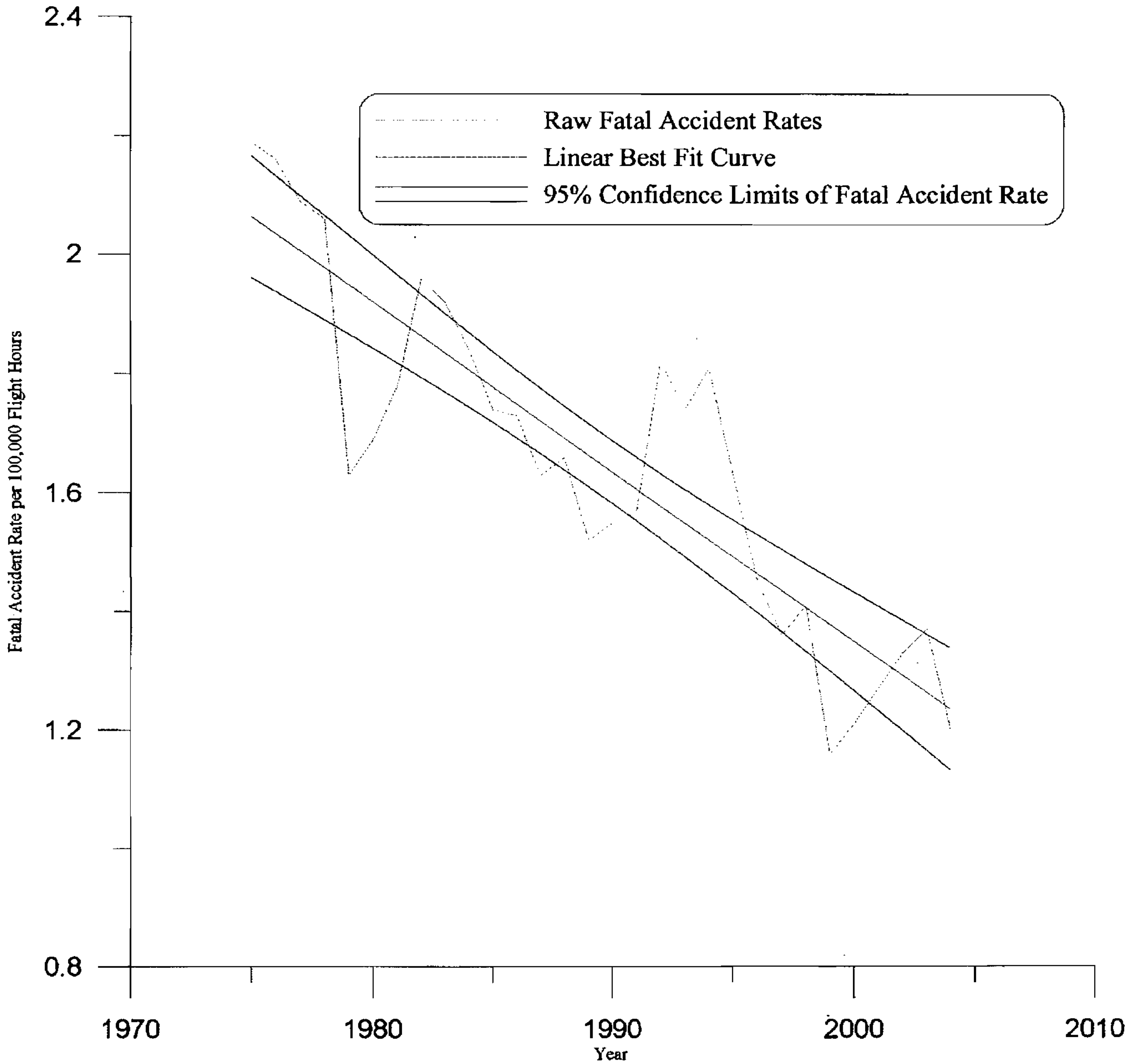

Figure 1. U.S. General Aviation Fatal Accident Rates (all causes) in Fatal Accidents per 100,000 Hours.

The confidence bands depicted in Figure 1 give an indication of the range of values the actual accident rate may fall within with a probability of 0.95. The lower confidence band in Figure 1 intersects the year 2005 at about 1.0. This indicates that a conservative estimate of the current fatal accident rate is 1 in 100,000 hours or 1×10^{-5} per flight hour.

Since the fatal accident rate is lower than the overall accident rate, we may conservatively choose 1×10^{-5} per flight hour as the overall target level of safety for flights of general aviation aircraft. An overflight of an exhaust plume is just one of many factors that could cause an accident or incident. When the number of factors that could cause a failure or accident is essentially unknown, standard engineering practice is applied.

Standard engineering practice assumes there are 100 possible causes and apportions the probability equally between the assumed factors. Therefore, since the overall target level of safety is 1×10^{-5} per flight hour, the target level of safety for overflight of an exhaust plume would be $1 \times 10^{-5} / 10^{2} = 1 \times 10^{-7}$ per flight hour.

From Table 1 we see that there were approximately 849,291,000 flight hours by general aviation aircraft during the time period 1975 to 2004. During this time period a careful search of the available aviation databases revealed that zero accidents or incidents related to overflight of a plume have been reported. This implies that the probability of an accident or incident caused by overflight of a plume is very small. If there were just one reported accident or incident, the estimated rate would be 1/849,241,000 or 1.2×10^{-9}. If there were two reported accidents or incidents, the estimated rate would be 2/849,241,000 or 2.4×10^{-9}. Therefore, it is safe to conclude that the accident/incident rate for overflights of exhaust plumes is of the order of 10^{-9} or less. Since the target level of safety was determined to be 1×10^{-7}, the probability of an accident or incident from overflight of an exhaust plume is less than the target level of safety. Since the target level of safety is met, the likelihood of an accident or incident caused by overflight of an exhaust plume is acceptably small.

Human Factors Assessment

Power plant exhaust plumes do not present an immediate or critical increase in human mental or physical workload, resulting in any commensurate decrease in performance. However, like any phenomenon in the NAS, pilots need to be properly armed with the knowledge that it exists. This prior knowledge allows for proper flight planning of routes and avoidance strategies, thus eliminating inadvertent visual or physical contact with a plume. As in any operation in the NAS, pilot comfort levels directly impact anxiety that subsequently may cause an increase in self-induced levels of stress and mental/physical workload. The more knowledge pilots have access to regarding any respective flight, the more comfortable he/she is. It is strongly advised that the existence of plumes in a flying area be published and disseminated to pilots for the reasons mentioned above. Pilots should be prepared to see and avoid power plant exhaust plumes just as they would be prepared to see and avoid any obstacle in their flight path, expected or unexpected. We would expect that any plume encounter would be a relatively benign event. The pilot's mental and/or physical resources would not be so task-overloaded as to preclude a safe maneuver out of, and away from the condition.

Preliminary Risk Assessment

A preliminary risk assessment of the two identified hazards was completed during brainstorming sessions by the technical team consisting of the previously mentioned FAA SME. The risk associated with a hazard is the composite of predicted severity (Table 2) and likelihood (Table 3) of the potential effect or outcome of the hazard in the worst credible system state. The following SMS Manual matrixes were used to develop the risk matrix for overflight of vertical plumes. The "Flying Public" row of the "Effect On" column was utilized for Severity and the "Qualitative ATC Service/NAS Level System" column was used for Likelihood.

Table 2 - Severity definitions

Effect On: ↓	Hazard Severity Classification				
	No Safety Effect 5	**Minor** 4	**Major** 3	**Hazardous** 2	**Catastrophic** 1
Air Traffic Control	Slight increase in ATC workload	Slight reduction in ATC capability or significant increase in ATC workload	Reduction in separation as defined by a low/moderate severity operational error (as defined in FAA Order 7210.56) or significant reduction in ATC capability	Reduction in separation as defined by a high severity operational error (as defined in FAA Order 7210.56) or a total loss of ATC Capability (ATC Zero)	Collision with other aircraft, obstacles or terrain
Flying Public	- No effect on flight crew - Has no effect on safety - Inconvenience	- Slight increase in flight crew workload - Slight reduction in safety margin or functional capabilities - Physical discomfort of occupants	- Significant increase in flight crew workload - Significant reduction in safety margin or functional capability - Physical distress possibly including injuries	- Large reduction in safety margin or functional capabilities - Serious or fatal injury to small number of occupants or cabin crew - Physical distress/ excessive workload	Outcome would result in: - Hull loss - Multiple fatalities

Table 3 - Likelihood Definitions

	NAS System			Flight Procedures	Operational	
	Quantitative[1]	Qualitative: Individual Item/System	Qualitative: ATC Service/ NAS Level System[3]		Per Facility	NAS-wide[4]
Frequent A	Probability of occurrence per operation/operational hour is equal to or greater than $1x10^{-3}$	Expected to occur frequently in an item	Continuously experienced in the system	Probability of occurrence per operation/ operational hour is equal to or greater than $1x10^{-5}$	[illegible]	Expected to occur every 1-2 days
Probable B	Probability of occurrence per operation/operational hour is less than $1x10^{-3}$, but equal to or greater than $1x10^{-5}$	Expected to occur several times in the life of an item	Expected to occur frequently in the system		[illegible]	Expected to occur several times per month
Remote C	Probability of occurrence per operation/operational hour is less than $1x10^{-5}$ but equal to or greater than $1x10^{-7}$	Expected to occur sometime in the life cycle of an item	Expected to occur several times in system life cycle	Probability of occurrence per operation/ operational hour is less than $1x10^{-5}$ but equal to or greater than $1x10^{-7}$	[illegible]	Expected to occur about once every few months
Extremely Remote D	Probability of occurrence per operation/operational hour is less than $1x10^{-7}$ but equal to or greater than $1x10^{-9}$	Unlikely but possible to occur in an item's life cycle	Unlikely but can reasonably be expected to occur in the system life cycle	Probability of occurrence per operation/ operational hour is less than $1x10^{-7}$ but equal to or greater than $1x10^{-9}$	[illegible]	Expected to occur about once every 3 years
Extremely Improbable E	Probability of occurrence per operation/operational hour is less than $1x10^{-9}$	[illegible]	Unlikely to occur, but possible in system life cycle	Probability of occurrence per operation/ operational hour is less than $1x10^{-9}$	[illegible]	Expected to occur less than once every 30 years

Preliminary Risk

Figure 2 reflects the definition of risk being the composite of severity and likelihood. This matrix classifies risk into three levels: High, Medium, and Low. The risk levels used in the matrix are defined as:

- **High risk** – unacceptable risk.

- **Medium risk** – acceptable risk; minimum acceptable safety objective; proposal may be implemented, but tracking and management are required.
- **Low risk** – acceptable without restriction or limitation; hazards are not required to be actively managed, but are to be documented.

The safety risk team preliminary risk assessment matrix in Figure 2 indicates where the initial hazards (H1/H2) identified by overflight of vertical plumes (in the takeoff/landing phase 1,000 feet AGL and below) would be situated on the risk matrix without considering or implementing any of the mitigations previously discussed. The team performed their analysis of the predictive risks associated with the plumes and determined the effects of both H1 and H2 hazards as low, or in the green section of the risk matrix. As a result of this assessment, the risk associated with plumes is deemed acceptable without restriction, limitation, or further mitigation.

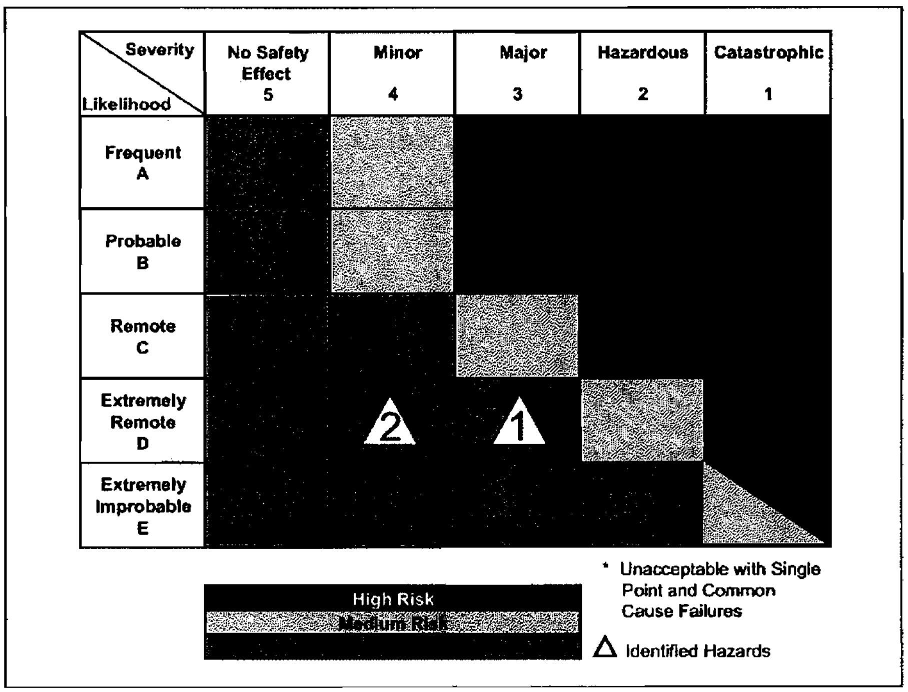

Figure 2 – Preliminary Risk Matrix Without Mitigation (current Risk)

Section 4 - Summary of Risk Analysis Team Deliberations

The review of the material in Section 2, the statistical analysis of data and the in-depth professional discussion, experience, and knowledge of SMEs on the team, led to the following preliminary observations:

- Given the virtually non-existent accident/incident safety data by either GA or commercial aviation pilots, the team was extremely confident in drawing the preliminary inference that hazard(s) associated with plume overflight represent an extremely low risk to aviation and the flying public.
- However, and in light of supporting data to the contrary, the team agreed that intentional and/or inadvertent overflight of industrial plumes at low altitudes (less than 1,000 feet above) during high velocity operation of the facility could possibly result in aircraft upset and a resultant incident or accident.
- The team determined that low, close-in operations at small to medium size airports by general aviation (GA) aircraft, particularly aircraft under 12,500 lbs. and those in the Light Sport Aircraft (LSA) category, would be of greatest potential concern.
- The SME team considered and discussed their belief that safety data which indicated few, if any accidents/incidents attributable to the issue may be a reflection of the cumulative actions over many years of prudent aviators and ATC personnel. This includes knowledge of and training in established "see-and avoid" techniques and/or mitigating operational procedures. The situation with plumes was deemed similar to many hazards present in the NAS today (see AIM Chapter 7 for further examples). Moreover, rules and regulations restricting the altitude for overflight of power plant facilities coupled with pilot training, alerting, and the common sense aviator aptitude were determined to be the major factors in the scarcity of associated data and resultant low risk factor.
- At airports where power plants could not be optimally avoided by current approach procedures or when weather resulted in plume footprints that could adversely affect airport operations, ATC past and present operational procedures were deemed more than adequate to maintain established acceptable levels of risk.
- Plume effects (H2) on aircraft, engine component function, and/or corrosion were deemed inconsequential by the SME team.
- The team noted the CASA flight restriction of 4.3m/s above OLS or 110 (meters) AGL as less restrictive than the 14 CFR Part 91 restrictions previously mentioned.

Section 5 – Conclusions, Recommendations, and Residual Risk

Safety is freedom from unacceptable risk. Everyday in the NAS aircraft and airmen operate with hazards that constantly present various levels of risk. From bird strikes, to engine failures, to runway incursions, these situations present vastly different scenarios for the pilot, crew, and ATC personnel to consider. However, these hazards all have one characteristic in common – they represent ***acceptable risk*** that is considered and mitigated as necessary to allow flight operations to proceed to a safe conclusion in the vast majority of cases.

Many of these risks represent far greater concern and thereby require a more complicated Risk Control Strategy or mitigation effort than the issue addressed by this study.

Our interpretation of available data is not so much that plumes are not hazards or present zero risk, but that pilots and controllers operating within the NAS have been and will continue to apply prudence and common sense skills to constantly "see and avoid" any potential hazard. These mitigating techniques are employed everyday throughout NAS through timely communication, training, and procedures for operating near hazardous weather, forest fires, large sporting events, volcanic ash, migratory bird activity, antenna towers, and overhead wires.

The risk assessment team offers the following conclusions and recommendations with regard to "overflight of plumes" and associated hazards:

Conclusions:

1. Given the considerably large pool of safety data available, it is safe to conclude that the accident/incident rate for overflights of exhaust plumes is of the order of 1×10^{-9} or less. Since the target level of safety was determined to be 1×10^{-7}, the probability of an accident or incident from overflight of an exhaust plume is less than the target level of safety. Since the target level of safety is met, the current likelihood of an accident or incident caused by an overflight of an exhaust plume is acceptably small.

2. Current regulations and advisories as well as the present Notice to Airmen (NOTAM) Temporary Flight Restrictions should preclude prudent pilots from flying through or near plumes, thereby making the aviation risk essentially zero.

3. Safety data and TLS notwithstanding, the FAA believes that flight over or around plume generating facilities should be avoided as there is the *potential* (however low) for aircraft upset at close proximity to high velocity plumes.

Recommendations:

Given the extremely low risk these plumes present, further mitigation is not required. However, the risk assessment team would offer that the FAA continue to enhance awareness programs that have been successful with similar hazards of acceptable risk levels. These programs include pilot and ATC personnel professional education, communication, advisement and avoidance strategies, and operational techniques. Accordingly, the safety risk assessment team recommends the FAA:

(a) Amend the Aeronautical Information Manual (AIM) Chapter 7, Section 5 with wording to the effect that overflight at less than 1,000 feet vertically of plume generating industrial sites should be avoided.

(b) Publish (as appropriate) the position and nature of the present power plants located near public airports in the Airport/Facility Directory (A/FD), and issue a Notice to Airmen (NOTAM) when operationally necessary.

(c) Make the Temporary Flight Restriction (TFR) that includes the overflight of power plants (which was issued primarily for national security purposes) - a permanent flight restriction where operationally feasible.

(d) Amend FAA Order 7400.2 to consider a plume generating facility as a hazard to navigation when expected flight paths pass less than 1,000 feet above the top of the object.

(e) Advisory Circular 70/7460-2K Proposed Construction of Objects That May Affect the Navigable Airspace - Change Instructions for Completing FAA Form 7460-1 – Notice of Proposed Construction or Alteration, Item # 21, to add:

> "For structures such as power plants or any industrial facility where exhaust plume discharge could reasonably be expected and reportable under the provisions of Part 77, thoroughly explain nature of the discharge."
>
> Amend the AC as necessary to explain this change.

Residual Risk

A risk matrix, as shown in Figure 3, indicates where the residual risk of the hazards identified with the overflight of vertical plumes are situated with the implementation of the recommendations described above.

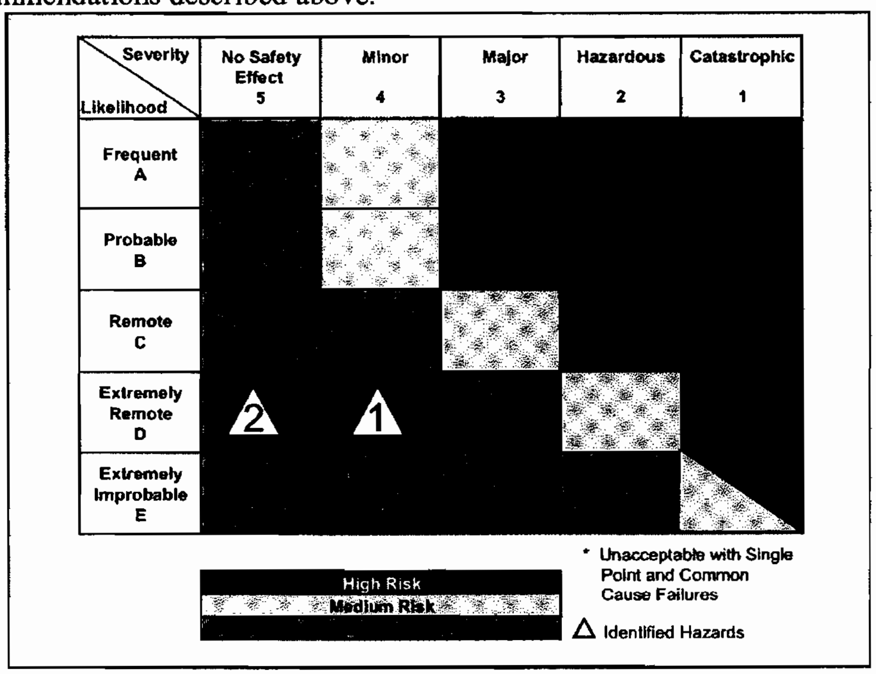

Figure 3 – Risk Matrix with Mitigation* (Residual Risk)
* Not required

Glossary of Terms

Aviation Safety Reporting System (ASRS) and Aviation Safety Reporting Program (ASRP). ASRS and ASRP are voluntary programs designed to encourage the identification and reporting of deficiencies and discrepancies in the airspace system. The National Aeronautics and Space Administration (NASA) accomplishes receipt, processing, and analysis of raw data rather than the FAA, which ensures the anonymity of the reporter and of all parties involved in a reported occurrence or incident and, consequently, increase the flow of information necessary for the effective evaluation of the safety and efficiency of the system. [Advisory Circular 00-46, *Aviation Safety Reporting Program]*

Accident. An event associated with the operation of an aircraft that takes place between the time any person boards the aircraft with the intention of flight and until all such persons have disembarked, and in which any person suffers death or serious injury, or in which the aircraft receives substantial damage.

Accident/Incident Reporting Data System (AIDS). The FAA AIDS database contains accident and incident data records for all categories of civil aviation.

Assessment. An estimation of the size/scope of risk or quality of a system or procedure.

Effect. The effect is a description of the potential outcome or harm of the hazard if it occurs in the defined system state.

14 CFR Part 91 (General Aviation). Prescribes the operation of aircraft (other than moored balloons, manned rockets, and unmanned free balloons, which are governed by CFR Part 101, and ultralight vehicles operated in accordance with CFR Part 103) within the United States, including the waters within three nautical miles of the U.S. coast. Flights operating for recreation and training are generally carried out under CFR Part 91. Although general aviation usually involves small aircraft, the definition depends on the nature of the operation rather than the size of the aircraft.

14 CFR Part 121 (Air Carrier). Refers to scheduled domestic airlines and cargo carriers that fly large transport category aircraft.

14 CFR Part 135 (Air Taxi and Commuter). Refers to either scheduled (commuter operations) or nonscheduled (air taxi operations) flights. Scheduled CFR Part 135 operations apply to smaller aircraft carrying nine or fewer passengers on regularly scheduled routes. Nonscheduled CFR Part 135 operations apply to smaller aircraft carrying nine or fewer passengers with schedules that are arranged between the passengers and the operator. The nonscheduled operations also include cargo planes with payload capacities of 7,500 pounds or less.

14 CFR Part 137 (Agricultural). Refers to agricultural aircraft operations. Agricultural aircraft operation means the operation of an aircraft for the purpose of (1) dispensing any economic poison; (2) dispensing any other substance intended for plant nourishment, soil treatment, propagation of plant life, or pest control; or (3) engaging in dispensing activities directly affecting agricultural, horticultural, or forest preservation, but not including the dispensing of live insects.

Fatal Injury. The NTSB defines a fatal injury as any event that results in death within 30 days of the event.

Hazard. Any real or potential condition that can result in injury, illness, or death to people; damage to, or loss of a system (hardware or software), equipment or property; and/or damage to the operating environment. A hazard is a prerequisite to an accident or incident.

Hazard Tracking. Hazard tracking is a closed-loop means of ensuring that the requirements and mitigations associated with each hazard that has associated medium and/or high risk are implemented. Hazard tracking is the process of defining safety requirements, verifying implementation, and reassessing the risk to make sure the hazard meets its risk level requirement before being accepted.

Incident. The NTSB defines an incident as an event, other than an accident, associated with the operation of an aircraft that affects or could affect the safety of operations.

Likelihood. Likelihood is an expression of how often an event is expected to occur. Severity must be considered in the determination of likelihood. Likelihood is determined by how often the resulting harm can be expected to occur at the worst credible severity, which will usually occur in the worst credible system state.

Mitigation. An action taken to reduce the risk of a hazard.

National Airspace System (NAS). An integrated set of constituent pieces that are combined in an operational or support environment to accomplish a defined objective. These pieces include people, operational environment, usage, equipment, information, procedures, facilities, services, and other support services.

National Aviation Safety Data Analysis Center (NASDAC). The NASDAC system enables users to perform queries across multiple databases and display queries in useful formats. The NASDAC is a data warehouse and integrated database system.

Plume. Thermal updrafts generally associated with exhaust from the smoke stacks of power generating facilities, industrial production facilities, or other systems, which could have the ability to release large amounts of pressurized or otherwise unstable air. Can be visible or invisible in the air and disperse at various velocities/rates and directions for a given facility output and atmospheric conditions.

Preliminary Hazard Analysis (PHA). A risk analysis tool used in the hazard identification process for nearly all risk management applications except the most time-critical.

The broad scope of this tool provides a guide to the identification of issues. The PHA considers all of the hazards inherent to each aspect of an operation, without regard to risk. The PHA helps overcome the tendency to focus immediately on risk in one aspect of an operation, sometimes at the expense of overlooking more serious issues elsewhere in the operation.

Process. An organized group of related activities that work together to produce a desirable condition.

Qualitative Data. Subjective data is expressed as a measure of quality; nominal data.

Quantitative Data. Objective data expressed as a quantity, number or amount that allows for more rational analysis and substantiation of findings.

Risk. The risk associated with a hazard is the composite of predicted severity and likelihood of the potential effect or outcome of the hazard in the worst credible system state. The two types of risk addressed in this study are, (1) current, (2) residual:

> **Current.** Current risk is the predicted severity and likelihood of an effect associated with a hazard at the current time.
>
> **Residual.** Residual risk is the remaining risk that exists after all control/mitigating techniques have been implemented or exhausted.

Risk Assumption Strategy. To accept the likelihood, probability, and consequences associated with the risk.

Risk Avoidance Strategy. To select a different approach or to not participate in the operation, procedure, or system development to avert the potential of occurrence and/or consequence.

Risk Control Strategy. To develop options and alternatives and/or take actions to minimize or eliminate the risk.

Safety. Freedom from unacceptable risk.

Safety Management System (SMS). An integrated collection of processes, procedures, policies, and programs that are used to assess, define, and manage the safety risk in the provision of air traffic control (ATC) and navigation services.

Safety Risk Management (SRM). A formalized, proactive approach to system safety. SRM is a methodology usually applied to all (NAS) changes that ensures all risks are identified and mitigated prior to the change being made. For the purposes of this study, SRM provides a flexible "closed-loop" safety analysis framework well-suited to the analysis of presumed hazards.

Severity. Severity is the measure of how bad the results of an event are predicted to be. Severity is determined by the worst credible potential outcome.

Substantial Damage – The NTSB defines substantial damage as failure that adversely affects the structural strength, performance, or flight characteristics of the aircraft, and would normally require major repair or replacement of the affected component. Engine failure or damage limited to the engine if only one engine fails or is damaged, bent fairings or cowlings, dented skin, small puncture holes in the skin or fabric, ground damage to rotor or propeller blades, and damage to landing gear, wheels, tires, engine accessories, brakes, or wingtips are not considered "substantial damage."

Target Level of Safety (TLS). The target level of safety is the maximum allowable probability of a hazardous event. The target level of safety is usually determined from historical data for various operations, but is sometimes developed through analysis.

"What - if" Technique. Is a brainstorming method designed to add discipline and structure to the experiential and intuitive expertise of operational personnel.

Worst Credible System State. In this definition, "*worst*" is the most unfavorable conditions expected (e.g., extremely high levels of efflux material and velocity, extreme weather disruption, etc.); "*credible*" implies that it is reasonable to expect the assumed combination of extreme conditions will occur within the NAS.

Appendix A – Risk Assessment Team Members

Name	Organization/Position
Alan Jones	AFS-420/Operations Research Analyst
Dr. James Yates	AFS-420/FAA Contractor-ISI, Senior Engineer & Pilot
Dean Alexander	AFS-440/ Test Director & Airspace System Inspection Pilot
Rick Dunham	AFS-440/ Test Director & Airspace System Inspection Pilot
Lt. Col Paul McCarver	AFS-420/USAF Pilot & Military Liaison
Michael Werner	AFS-420/Pilot & Aviation Safety Inspector (Operations)
Gary Powell	AFS-420/Pilot & Aviation Safety Inspector (Operations)
Larry Ramirez	AFS-440/Air Traffic Control Liaison
James Nixon	AFS-420/FAA Contractor-ISI, Pilot & Approach Procedure Specialist
Mark Reisweber	AFS-440/Engineering Psychologist (Human Factors) & Pilot
John Holman	AFS-420/FAA Contractor-ISI, Pilot & Approach Procedure Specialist

Cultural Resources

Data Request Responses 57-62

Cultural Resources (57-62)

Cultural Survey Results

57. *Please survey the City of Hayward parcel to the east of the proposed transmission line route, the transmission line route between Depot Road and the City of Hayward parcel, the parking/laydown area to the west of the project site, the Aladdin Depot Partnership and the alternate electrical transmission line route and provide the survey results.*

Response: The City parcel east of the transmission line route, transmission route between Depot Road and City of Hayward Parcel, Aladdin Depot Partnership parcel and alternative electrical transmission line routes are currently all in areas of heavy industrial or construction use. They are not accessible and the ground surface in these areas is covered by salvaged automobiles, stored containers, and other items that constrain ground surface visibility. For these reasons, Applicant proposes that these areas be surveyed during the construction preparation phase when these areas are accessible and when there is a greater chance of surveyors seeing the original ground surface without it being obscured by automobiles or other objects. Figure DR21-1 from the previous submittal incorrectly does not show the area immediately west of the project site within the City's current sludge drying yards as having been surveyed. This area was surveyed as part of the original AFC proceeding.

Cultural Survey Areas

58. *Please identify areas on a revised Figure DR21-1 where access cannot be obtained or the ground is not visible, and provide a discussion of the steps taken to obtain access or a plan for conducting an archaeological survey at a later date when the ground is visible. If access cannot be obtained or the ground is not visible, please explain how the project proposes to conduct necessary archaeological surveys.*

Response: Figure DR58-1 shows areas for which site access is currently not available or the ground surface is not visible due to gravel fill and the presence of salvage automobiles, cargo containers, or other objects that prevent the surveyor from viewing the ground surface. Applicant proposes that these areas be surveyed during the construction preparation phase when these areas are accessible and when there is a greater chance of surveyors seeing the original ground surface without it being obscured by automobiles or other objects.

Native American Consultation

59. *Please identify when the project owner anticipates providing information regarding Native American responses to staff. If responses have been received, please provide copies of response letters and a summary of telephone conversations.*

Response: Attachment DR59-1 contains the records of conversations with Native American organizations or individuals identified in the Native American Heritage Commission's consultation list.

Soil Borrow Sites

60. *If soils will be purchased from a borrow site that is not a commercial location and consequently has not been surveyed for cultural resources, please conduct a cultural resources survey and provide the survey personnel qualifications, methods, and findings to staff.*

Response: It is anticipated that any soils purchased for fill will be purchased from a borrow site that is a commercial location. The final determination of borrow site locations needed for construction will be made after licensing and in the final stages of construction planning. Any sites identified at that time as borrow locations that would not be commercial locations would be identified as part of the RCEC project description in an amendment to the license application.

Soil Disposal Sites

61. *Please explain whether soil disposal sites to be used for the proposed project are commercial locations. If they are not commercial locations and consequently have not been surveyed for cultural resources, please conduct surveys of disposal site(s) and provide the survey personnel qualifications, methods, and findings to staff.*

Response: It is anticipated that any soil disposal that would be necessary would take place at a commercial location or hazardous waste landfill. The final determination of this will be made after licensing and in the final stages of construction planning. Any sites identified at that time as disposal sites that would not be commercial locations or hazardous waste landfills would be identified as part of the RCEC project description in an amendment to the license application.

Historical Background Research

62. *Please have an architectural historian or a historian, who specializes in industrial history (that meets the Secretary of Interior Standards), conduct sufficient historic background research to answer the questions asked in previous Data Request #27. The BSO forms must make a clear well-supported recommendation regarding eligibility of the three historic buildings to the CRHR. Please provide the updated BSO forms to staff.*

Response: Additional background research on the Eash Buildings is underway and will be provided to Staff when completed on or before the March 30.

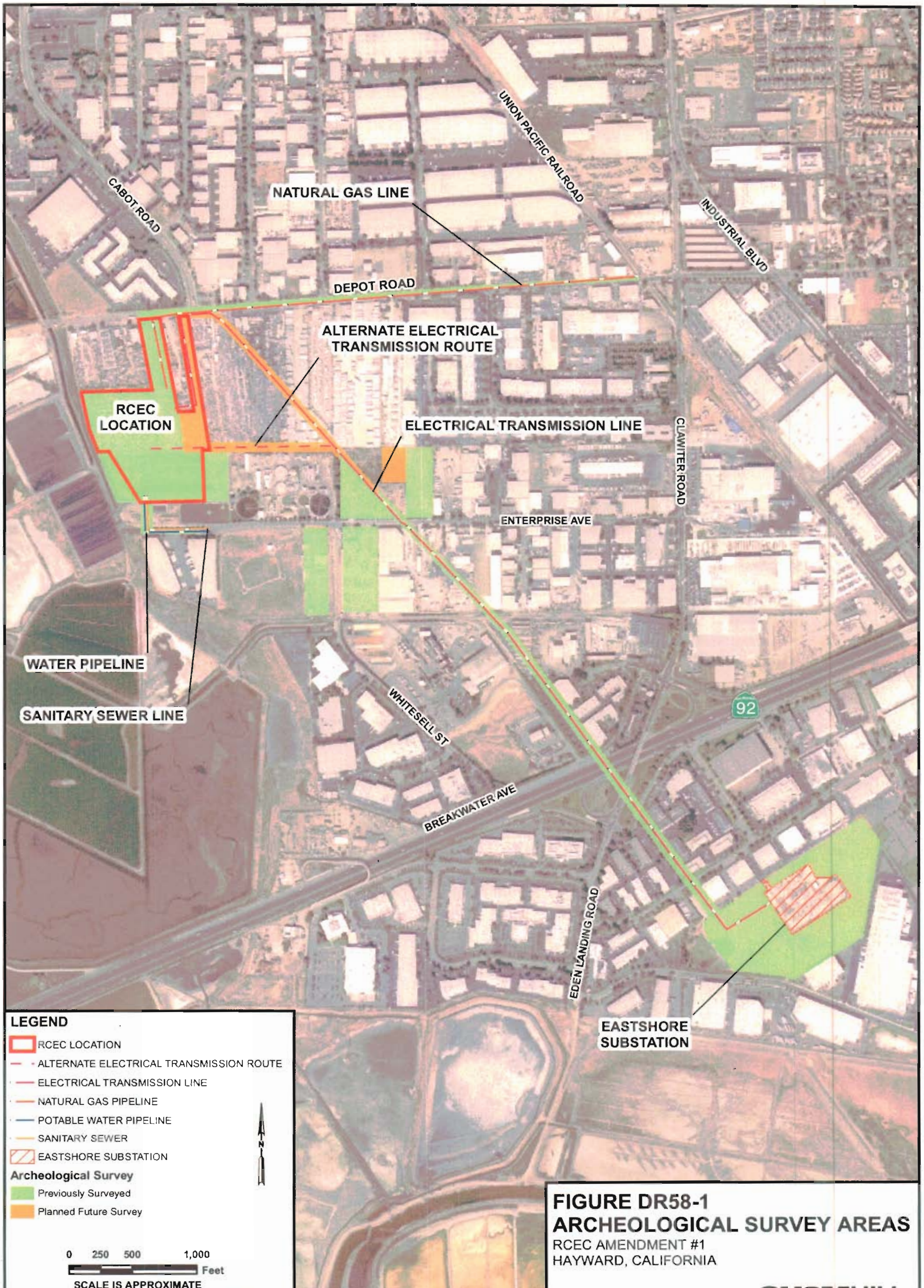

FIGURE DR58-1
ARCHEOLOGICAL SURVEY AREAS
RCEC AMENDMENT #1
HAYWARD, CALIFORNIA

CH2MHILL

SAC\\GLACIER\PROJ\349499_RUSSELLCITY\MAPFILES\ARCHEOLOGY_SURVEY.MXD 1/10/2007 09:17:13

Attachment DR59-1

Native American Records of Conversation

RCEC NAHC Contact List

Recipient	Date Sent	Mailed	E-Mailed	Phone	Comments
Jakki Kehi 720 North 2nd Street Patterson, CA 95363	1/15/07	X	No	X – 3/20/07, 230PM	Will not comment on site until records search with site map w/ 1 mile radius is provided to her.
Katherine Erolinda Perez P.O. Box 717 Linden, CA 95236	1/15/07	X	Undeliverable via email	X – 3/20/07, 145PM	LMAM
Michelle Zimmer Amah/Mutson Tribal Band Cultural Resource Coordinator P.O. Box 62-558 Woodside, CA 94062	1/15/07	X	No	X – 3/20/07, 150PM	LMAM
Irene Zwierlein Amah/Mutsun Tribal Band Chairperson 789 Canada Road Woodside, CA 94062	1/15/07	X	No	X – 3/20/07, 155PM	Referred me to Andrew Galvan. There is nothing in the area that she is aware of, and advised me to contact Andy as he is very aware of cultural resources in the area.

RCEC NAHC Contact List

Recipient	Date Sent	Mailed	E-Mailed	Phone	Comments
Ann Marie Sayers Indian Canyon Mutsun Band of Costanoan P.O. Box 28 Hollister, CA 95024	1/15/07	X	No	No phone number available.	
Rosemary Cambra Muwekma Ohlone Indian Tribe of the SF Bay Area P.O. Box 360791 Milpitas, CA 95036	1/15/07	X	Yes	X – 3/20/07, 200PM	LMAM
Andrew Galvan The Ohlone Indian Tribe P.O. Box 3152 Mission San Jose, CA 94539	1/15/07	X	Yes	X – 3/20/07, 210PM	LMAM
Ramona Garibay Trina Marine Ruano Family 16010 Halmar Lane Lathrop, CA 95330	1/15/07	X	No	X – 3/20/07, 205PM	Nothing in area that she is aware of.

NOTES

LMAM – left message on answering maching

From: Madams, Sarah/SAC
Sent: Tuesday, March 20, 2007 3:00 PM
To: 'muwekma@muwekma.org'
Subject: Russell City Energy Center Cultural Resource Survey

Attachments: Cambra.pdf
Ms. Cambra-

My name is Sarah Madams and I am with CH2M HILL, an environmental engineering firm, which is currently preparing a cultural resource survey for the Russell City Energy Center located in Hayward, California. I received your name from the Native American Heritage Commission as you may have additional information regarding this particular site. Attached please find a copy of the letter and map that were sent to you earlier this year in regards to this project. At your earliest convenience please feel free to contact me either through phone, fax or email if there are any resources in this area that you may be aware of.

Thank you,
Sarah Madams

Sarah Madams
CH2M HILL
2485 Natomas Park Dr., Ste. 600
Sacramento, CA 95833
Phone: 916-286-0249
Fax: 916-614-3449

From: Madams, Sarah/SAC
Sent: Tuesday, March 20, 2007 3:00 PM
To: 'chochenyo@aol.com'
Subject: Russell City Energy Center Cultural Resource Survey

Attachments: Galvan.pdf

Mr. Galvan -

My name is Sarah Madams and I am with CH2M HILL, an environmental engineering firm, which is currently preparing a cultural resource survey for the Russell City Energy Center located in Hayward, California. I received your name from the Native American Heritage Commission as you may have additional information regarding this particular site. Attached please find a copy of the letter and map that were sent to you earlier this year in regards to this project. At your earliest convenience please feel free to contact me either through phone, fax or email if there are any resources in this area that you may be aware of.

Thank you,
Sarah Madams

Sarah Madams
CH2M HILL
2485 Natomas Park Dr., Ste. 600
Sacramento, CA 95833
Phone: 916-286-0249
Fax: 916-614-3449

From: Madams, Sarah/SAC
Sent: Tuesday, March 20, 2007 3:00 PM
To: 'canutes@comcast.net'
Subject: Russell City Energy Center Cultural Resource Survey

Attachments: Perez.pdf

Ms. Perez-

My name is Sarah Madams and I am with CH2M HILL, an environmental engineering firm, which is currently preparing a cultural resource survey for the Russell City Energy Center located in Hayward, California. I received your name from the Native American Heritage Commission as you may have additional information regarding this particular site. Attached please find a copy of the letter and map that were sent to you earlier this year in regards to this project. At your earliest convenience please feel free to contact me either through phone, fax or email if there are any resources in this area that you may be aware of.

Thank you,
Sarah Madams

Sarah Madams
CH2M HILL
2485 Natomas Park Dr., Ste. 600
Sacramento, CA 95833
Phone: 916-286-0249
Fax: 916-614-3449

CH2MHILL TELEPHONE CONVERSATION RECORD

Call To:	Jakki Kehl 720 North 2nd Street		Patterson, CA 95363
Phone No.:	209-892-2436	**Date:**	March 20, 2007
Call From:	Sarah Madams	**Time:**	2:30 PM
Message Taken By:	CH2M HILL		
Subject:	Russell City Energy Center Cultural Resource Study		

Spoke with Ms. Kehl regarding the Russell City Energy Center (RCEC). Per Ms. Kehl, in order to make a comment if there are any culturally significant areas near the project site, she will need a records search from Sonoma State, and a map identifying the site and one mile radius from the site. Off the top of her head she doesn't know if there are sites which is why she would need the records search from the area. In addition, unless envelopes are specifically marked with "report included" she may not have the time to review individual requests.

Specifically, Ms. Kehl wanted it documented that she will not determine if there are any culturally significant areas near the project site without a records search available to her first.

CH2MHILL TELEPHONE CONVERSATION RECORD

Call To:	Ramona Garibay, Trina Marine Ruano Family		
Phone No.:	510-300-5971	**Date:**	March 20, 2007
Call From:	Sarah Madams	**Time:**	2:05 PM
Message Taken By:	CH2M HILL		
Subject:	Russell City Energy Center Cutural Resource Study		

Contacted Ms. Garibay regarding potential cultural resources near the RCEC project site. Per Ms. Garibay, there is nothing she is aware of in this project area.

CH2MHILL TELEPHONE CONVERSATION RECORD

Call To: Irene Zwierlein
Amah/Mutsun Tribal Band
Chairperson
789 Canada Road
Woodside, CA

Phone No.: 650-851-7747 **Date:** March 20, 2007

Call From: Sarah Madams **Time:** 1:55 PM

Message Taken By: CH2M HILL

Subject: Russell City Energy Center Cutural Resource Study

Contacted Ms. Zwierlein regarding potential cultural resources near the RCEC project site. Per Ms. Zwierlein, there is nothing she is aware of, but advised me to contact Andrew Galvan as he is very knowledgeable about this project area.

Land Use

Data Request Responses 63-65

Land Use (63-65)

Aviation Safety

63. *Please discuss the suitability of the proposed project site and consistency with allowable uses within the Hayward Airport Approach Zoning Plan area (HMC §10-6), with respect to potential aviation safety hazards from plant-generated thermal plumes.*

Response: The proposed RCEC site would not cause a hazard to air navigation and would not "endanger the landing, take-off, or maneuvering of aircraft." The RCEC is located more than 1.5 miles from the nearest point of the nearest runway and is not located along or underneath any of the recognized approach patterns for airport landing or takeoff. The proposed RCEC structures also would not penetrate any of the Federal Aviation Administration's (FAA's) "imaginary surfaces" that define the protected airspace near a public airport, including the approach surface, transitional surface, or horizontal surface.

The City of Hayward's Airport Master Plan for Hayward Executive Airport (City of Hayward 2002) defines the airport's Traffic Pattern Zone, which extends about one mile from the airport runways and is the zone within which aircraft fly when circling the airport (See Hayward Executive Airport Master Plan, Exhibit 5B, and Figure DR55-1, above). RCEC is outside of and about one half-mile southwest of this boundary.

The Hayward Airport Master Plan also mandates certain flight pathways for aircraft to follow for residential zone noise abatement. Aircraft taking off from the airport must follow certain clearly defined patterns to avoid flying over residential areas at low altitude. Neither the Preferred Departure Paths, Touch-n-go Traffic Pattern, or Helicopter Operations paths fly over the RCEC site or come any nearer than one half-mile from the RCEC site (Hayward Executive Airport Master Plan, Exhibit 1C, and Figure DR55-2, above). In addition, the Pattern Altitude (the altitude at which aircraft are required to fly when circling the runway for landing approach) is 600 feet for Runway 28L-10R and 800 feet for Runway 28R-10L. The tallest RCEC structure (HRSG stacks) would be 145 feet high.

Neither would hot air exhaust plumes from the RCEC's stacks cause a hazard to air navigation. The FAA recently conducted a study to assess the risk of aircraft flying over industrial exhaust plumes, included here as Attachment DR55-1 (in response to Data Request 55) and titled "Safety Risk Analysis of Aircraft Overflight of Industrial Exhaust Plumes." This study examined the available databases of pilot reports and accident/incident reports over a thirty-year period. These data included more than 670,000 pilot reports and more than 150,000 accident/incident records. The study's authors determined that there were no accidents due to or involving industrial exhaust plumes and only one, unconfirmed, incident during this time. The study determined that the risk of accident would be one in a billion, two orders of magnitude below the FAA's safety standard of one in 10 million. The report concluded that the risk would be "extremely low" and that "*the risk associated with plumes is deemed acceptable without restriction, limitation, or further mitigation* (italics added)." The report also states:

> Current regulations and advisories as well as the present Notice to Airmen (NOTAM) Temporary Flight Restrictions should preclude prudent pilots from flying through or near plumes, thereby making the aviation risk essentially zero (p. 16, Conclusion 2).

Thermal plumes are discussed further in this document in responses to Data Requests 64 through 68.

Industrial Zoning District

64. *Please discuss the consistency of the new project site with the policies, provisions, and intent of the revised 2002 Hayward General Plan, compatibility with uses identified as appropriate within the Industrial (I) zoning district, and use restrictions, per Hayward Municipal Code §10-6.35 (Airport Approach Zone).*

Response: The project as amended is in virtually the same location as the currently certified project. The southern boundary of the project as amended is approximately 300 feet from the northern boundary of the currently certified project (Amendment, p. 1). As a result of this very slight change, the project as amended is able to avoid impacts to a greenfield site, avoid impacts to seasonal wetlands and avoid impacts associated with the relocation of the KFAX radio antenna towers. The RCEC remains adjacent to a major industrial facility—the Hayward Water Pollution Control Facility.

Consistency with the 2002 Hayward General Plan

The consistency of the currently certified project with the 2002 Hayward General Plan was expressly addressed in the original AFC proceeding. The original Application (filed in May 2001) addressed proposed revisions to the Hayward General Plan that were then under consideration by the City (AFC, pp. 8.6-9, 10). The AFC described specific recommendations that were under consideration by the City as part of this General Plan update.[1] The updated 2002 Hayward General Plan was adopted in March 2002. These revisions were also explicitly addressed by the Staff Assessment issued in June 2002.[2] After carefully considering these revisions to the General Plan, the Staff Assessment concluded that "The proposed use would be consistent with the policies of the City of Hayward's General Plan" (Staff Assessment, June 10, 2002, p. 4-5-12).

The Commission considered both the Application and the Staff Assessment when it approved the RCEC project: "The Staff witnesses Jon Davidson and David Flores sponsored the Staff's independent analysis of Land Use issues in Section 4.5 of the FSA (Ex. 1; RT 36-38). In this analysis, the Staff determined that the proposed RCEC project would comply with the City of Hayward's LORS. The proposed project is appropriately sited in an area designated for industrial development in the General Plan. The City's General Plan policies concerning the Industrial Corridor are generally supportive of new industrial projects for economic development reasons, rather than restrictive or prohibitive. Staff has concluded that the proposed project does not conflict with any of the relevant land use policies

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[1] These recommendations, although not yet formally adopted in the updated General Plan were known to the City Council when it adopted Resolution 01-104.

[2] While the updated General Plan was adopted in March 2002, the Staff Assessment issued in June 2002 still referred to these changes as pending. However, the revisions described in the Staff Assessment were the same as those adopted in the updated General Plan.

contained in the Hayward General Plan (Ex. 1, p. 4.5-7 to 4.5-8; RCEC Final Decision, July 2002, p. 192).

It is thus clear that the Applicant, Staff, City of Hayward, and the Commission fully considered the 2002 update to the Hayward General Plan before the Commission certified the RCEC. The slight change in location does not materially affect the findings that the Commission made in 2002, after adoption of the updated Hayward General Plan, regarding the conformance of the project with this General Plan.

The Background to Questions 64 and 65 states that the

> discussion of the Industrial Corridor within the 2002 revised General Plan (Hayward 2002 General Plan, Section 2 - Land Use, pp. 5 and 12-16), indicates a trend away from siting heavy industrial and manufacturing uses in portions of the Industrial Corridor, although no specific use boundaries have been codified.

This statement is an oversimplification of the 2002 General Plan. That Plan did not indicate a trend away from industrial and manufacturing uses in the Industrial Zone. Instead, the General Plan stated that for over 40 years,

> the industrial area in western and southern Hayward has attracted warehouse and distribution facilities due to its easy access and central location within the East Bay. Today, these same qualities, along with less expensive land, are attracting high-tech and other firms looking for alternatives to high-priced San Francisco and the Silicon Valley....To further aid in this transition, the City is looking at ways to better accommodate the differing needs of new campus-style high-tech uses and *traditional manufacturing and warehousing uses*, perhaps through the establishment of separate zoning districts (emphasis added) (Hayward General Plan, p. 2-12).

To accommodate all of these differing uses, the 2002 General Plan made four recommendations regarding the Industrial Corridor. First, that the City consider the establishment of multiple zoning districts within the Industrial Corridor to better accommodate the differing needs of new high-tech uses and traditional manufacturing and warehousing uses (Hayward General Plan 2002, p. 2-14). As of this date, no such district in the vicinity of the RCEC has been proposed or adopted. We submit, however, that if such a zone were to be considered, it is likely that the Hayward Water Pollution Control Facility and immediately adjacent properties are likely to be placed in a traditional manufacturing/ heavy industry district.

Second, the 2002 General Plan suggested that the City consider allowing uses such as child care facilities in the industrial zone, in locations "such as the newer business parks, where these facilities could be located and pose little or no safety risks" (Hayward General Plan 2002, pp. 2-14 and 2-15). RCEC is not located near newer office parks, so this recommendation is not applicable to RCEC.

Third, the 2002 General Plan suggested increasing parking ratios or allowing on-street parking, so as not to discourage more intensive office uses within the Industrial Corridor

(Hayward General Plan 2002, p. 2-15). The RCEC will not require an increase in the parking ratio or on-street parking.

Fourth, the 2002 General Plan recommended increasing minimum parcel sizes from the current minimum of 10,000 square feet or prohibiting the subdivision of industrial land into parcels of less than one acre. The RCEC will be located on parcels much greater than one acre.

As the foregoing discussion illustrates, none of the recommendations directly relate to or impact the RCEC as originally proposed or as amended. Just as the currently certified RCEC was consistent with the 2002 General Plan, the RCEC as amended continues to be consistent with the 2002 General Plan..

Compatibility with the Industrial (I) zoning district

The compatibility of the RCEC with the City of Hayward General Plan was addressed by the City Council in Resolution 01-104. Section 10.1-1615 of the Hayward Municipal Code defines three categories of permitted uses within the Industrial District. The first category is "Primary Uses." Those uses listed as Primary Uses or those uses determined to be similar by the Planning Director, are permitted in the Industrial District as primary uses, when not adjacent to a residentially zoned property or properties, when not specified as an administrative or conditional use, and when the use is conducted completely within an enclosed building, provided that minor open storage may be permitted as an ancillary use. Industrial Uses and Manufacturing are specifically listed as Primary Uses.

Power generation is not listed as a Primary Use. However, in Resolution 01-104 (Attachment DR64-1), the Hayward City Council determined that the RCEC fits under and is similar to the primary use classification in the Industrial District zone of "Manufacturing," is consistent with the intent and purpose of the District and conforms with the zoning Ordinance. The City Council further determined that power plant use is similar to other existing uses in the Industrial District, such as the production of chemicals at the Rohm and Haas, Inc. paint polymers manufacturing plant.

Compatibility with Hayward Municipal Code §10-6.35 (Airport Approach Zone)

Hayward Municipal Code Section 10.6-35 states:

> SEC. 10-6.35 USE RESTRICTIONS. Notwithstanding any other provisions of this Article, no use may be made of land within any airport approach zone, airport turning zone or airport transition zone in such a manner as to create harmful electrical interference with radio communication between the airport and aircraft, make it difficult for flyers to distinguish between airport lights and other lights, result in harmful glare in the eyes of the flyers using the airport, impair visibility in the vicinity of the airport or otherwise endanger the landing, take off or maneuvering of aircraft.

Resolution 01-104 found that the RCEC conforms with the Zoning Ordinance. In its initial review of the project in 2001, the City (which is the operator of the Hayward Municipal Airport) did not express any concern that the RCEC might interfere with the operations of the Airport. Nevertheless, issues relating to aviation safety, including lighting and glare, were thoroughly considered by the Commission in the original proceeding. The Final Staff

Assessment addressed aviation safety issues related to the power plant, transmission lines and the relocated KFAX towers. The FSA concluded that with the implementation of Staff's proposed conditions of certification, impacts resulting from light and glare would be less than significant (FSA, p. 4.11-28). Regarding general aviation safety issues, the FSA concluded:

> The Russell City Energy Center has no major commercial aviation center in the area, with the Oakland International Airport located approximately seven miles to the northeast. The closest local airport is the Hayward Municipal Airport that is approximately one and a half miles to the northeast of the proposed project site. The runway is aligned with a northwest to southeast bearing. Aircraft will be expected to approach from those two directions and will not conflict with the proposed Russell City Energy Center facility.

Resolution 01-104

65. *Please discuss the project owner plan and schedule for amending Resolution 01-104 or obtaining a new amendment addressing the new project site's potential inconsistencies with the City's laws, ordinances, regulations, and standards (LORS).*

Response: The project owner has no plan to amend Resolution 01-104 or to obtain a new resolution. The project is in full compliance with the City's laws, ordinances, regulations and standards (LORS). We are not aware of any inconsistencies or potential inconsistencies with any applicable City LORS.

In Resolution 01-104 the City Council determined that the RCEC is consistent with the provisions of the General Plan and conforms to the Zoning Ordinance. The City Council did not make these findings lightly. Adoption of the Resolution followed extensive review by the Staff and a public hearing before the City Council.

In October 2005 the City once again reviewed the project. The review was required because the project owner asked the City if it could relocate the project onto a portion of the property used for the wastewater treatment plant. For use of this property, the project owner offered to exchange a portion of the formerly proposed RCEC location. This proposal was extensively reviewed by City Staff and by the City Council.

The City Manager recommended that the City Council approve the property exchange and support the project as revised. In making this recommendation, the City Manager determined that "in substance the new location is virtually the same as the original site and arguably better in terms of some of the impacts discussed during the original application process" (Attachment DR65-1). Because the substance of the new location is virtually the same, if not better, than the original location, the City Council did not find it necessary to modify the findings that it made in Resolution 01-104 regarding general plan and zoning conformance. Assuming, for the sake of argument, as the Staff suggests, that the earlier Resolution was location-specific, the evidence before the City Council was that the substance of the location was virtually the same, if not better. After a thorough discussion of the issues in a public hearing, the City Council again adopted a Resolution (Resolution 05-125, Attachment DR65-2) that expressed its support for the development and construction of the RCEC on the parcel the City agreed to exchange.

Clearly, the City Council would not and could not agree to exchange a parcel of land and enter into a cooperation agreement for a project that did not conform to the General Plan or the zoning ordinance. Because there was only a slight change in the location of the proposed project within the Industrial District, it was reasonable for the City to conclude that this was not a material change in the project and it was reasonable for the City Council to rely on the City Manager's report and reaffirm its support for the project without expressly adopting new findings regarding zoning or General Plan conformance. The two Resolutions of the Hayward City Council regarding the RCEC are entitled to a prima facie presumption of validity. (See, e.g., *Bownds v. City of Glendale (1980) 113 Cal.App.3d 875*, at pp. 885-886, 170 Cal.Rptr. 342.)

Attachment DR64-1

Hayward City Council Resolution 01-104

HAYWARD CITY COUNCIL

RESOLUTION NO. 01-104

Introduced by Council Member JIMENEZ

RESOLUTION FINDING THE RUSSELL CITY ENERGY CENTER POWER PLANT USE IS CONSISTENT WITH THE GENERAL PLAN AND ZONING ORDINANCE

WHEREAS, Calpine/Bechtel has made a request that the City of Hayward make a determination that a power plant (Russell City Energy Center) use at 366 Enterprise Avenue is consistent with the General Plan and is a use similar to a primary use permitted in the Industrial District; and

WHEREAS, the Russell City Energy Center (RCEC) is proposed for an area on Enterprise Avenue classified as "Industrial Corridor" in the General Plan and is zoned Industrial. Staff believes that the project is in conformity with the General Plan "Industrial Corridor" designation; and

WHEREAS, City Council finds that the RCEC fits under the primary use classification in the Industrial District zone of "Manufacturing", is consistent with the intent and purpose of the district, and conforms with the Zoning Ordinance.

WHEREAS, the power plant use is similar to other existing uses in the Industrial District, such as the production of chemicals at the Rohm & Haas, Inc., plant.

NOW THEREFORE BE IT RESOLVED that the City Council of the City of Hayward hereby finds and determines that the Russell City Energy Center power plant use is consistent with the provisions of the General Plan and the use is similar to the primary use of Manufacturing in the Industrial District required by the Zoning Ordinance.

IN COUNCIL, HAYWARD, CALIFORNIA July 10, 2001

ADOPTED BY THE FOLLOWING VOTE:

AYES: COUNCIL MEMBERS: Jimenez, Hilson, Rodriquez, Ward, Dowling, Henson
MAYOR: Cooper

NOES: COUNCIL MEMBERS: None

ABSTAIN: COUNCIL MEMBERS: None

ABSENT: COUNCIL MEMBERS: None

ATTEST: Angelina Reyes
City Clerk of the City of Hayward

APPROVED AS TO FORM:

City Attorney of the City of Hayward

Attachment DR65-1

City Manager's Report, Russell City Energy Center

CITY OF HAYWARD

AGENDA REPORT

AGENDA DATE 10/11/05

AGENDA ITEM 6

WORK SESSION ITEM

TO: Mayor and City Council

FROM: City Manager

SUBJECT: Cooperation and Option Agreement Regarding Russell City Energy Center

RECOMMENDATION:

It is recommended that the City Council adopt the attached resolution authorizing the City Manager to execute a cooperation and option agreement with RCEC-LLC in connection with the Russell City Energy Center.

DISCUSSION:

In 2001, the Calpine Corporation began the process to secure a license from the California Energy Commission (CEC) to construct the 600-megawatt Russell City Energy Center (RCEC). The RCEC was to be constructed on industrially-zoned property on Enterprise Avenue across the street from the City's wastewater treatment plant. This site was selected both because of the industrial character of the area, and because of the opportunity it presented to utilize effluent rather than potable water in the operation of the RCEC. Following an extensive review process, including public hearings held in Hayward, in September 2002 the CEC granted Calpine (technically, RCEC-LLC) a license to construct and operate the energy center. Owing to a change in economic circumstances, the RCEC has not been constructed, although the permit granted by the CEC remains valid.

Much has changed since 2002 with regard to how power plants are financed. At the start of the decade, it was possible to obtain needed financing in anticipation that a customer or customers for the energy would be identified subsequent to construction of the plant. Today, this is no longer the case. Now, power plant operators must demonstrate evidence that a long term power purchase contract is in place before financing will be provided. In this way, the contract serves as collateral to assure prospective investors there is sufficient revenue to meet debt service obligations.

Recently, Calpine has been participating in various bid processes initiated by business entities seeking the delivery of electricity on a long term basis. (Due to a confidentiality agreement, Calpine is not authorized to name the potential customer.) Calpine is proposing that the RCEC be the source of that power. For various reasons, the property on which Calpine planned to construct the RCEC is no longer available. As a result, Calpine has approached the City about utilizing a portion of City-owned property which houses the wastewater treatment plant to construct the RCEC. In total, City-owned property represents about 12.2 acres. In exchange for this property, Calpine proposes to convey to the City approximately 10.2 acres of land abutting the plant to the north. Some of the less intense functions associated with the wastewater facility could be transferred to the new site without adversely impacting the overall operation of the treatment plant. Although the City property is slightly larger, the properties are comparable inasmuch as the City property is encumbered by a number of underground pipes and other utilities which effectively reduce the area in which structures can be constructed. (See exhibit A for delineation of the parcels in question.)

The actual exchange however would not occur until and if Calpine has secured both a contract to provide electricity to its prospective customer, and the necessary financing as well. For this reason, the transaction is structured as an option. The option would be valid through December 31, 2006. (If the option in not exercised the properties are not exchanged.) If the option is exercised, but construction of the RCEC does not commence within three years following conveyance of the property, the exchanged parcels will revert to each conveying party.

In order for the RCEC to be constructed at this new site, Calpine must process an amendment to its existing license with the CEC. A provision of the agreement calls for the City to express its support for such an amendment. The City supported the original application and staff believes it is appropriate to support the amendment as well. As can be seen in the exhibit, in substance the new location is virtually the same as the original site and arguably better in terms of some of the impacts discussed during the original application process. Because of its new location, Calpine requests that the architectural screen which was included in the original design no longer be required. Often referred to as the "wave", the screen was intended to soften the size and bulk of the plant. Staff supports Calpine's request for its deletion, particularly since the new location makes the RCEC less visible to motorists entering Hayward via Route 92, which was the main reason the screen was incorporated in the original design.

As the Council will recall, Calpine previously agreed to provide a number of community benefits, the most substantial of which was a contribution to the City of $15 million for a new library. Other, significantly smaller, contributions were also to be provided to the Hayward Area Recreation and Park District, and the Hayward Education Fund. Due to changed economic conditions and a more competitive pricing environment, Calpine reports it can no longer provide the same level of support and still compete effectively in the open market. Consequently, it is no longer able to provide the planned benefits to the HARD and HEF. With respect to the library, after extensive discussions, staff has been successful in obtaining Calpine's commitment to help fund the library initiative—albeit at a lesser amount. Accordingly, Calpine now proposes to contribute $10 million to the City, which amount is to be conveyed when concrete is poured for the foundation for the turbines that are integral to the plant. (Apparently, this typically occurs within the first six to nine months of project construction.)

In addition to the exchange of parcels and the other elements described above the recommended agreement includes the following important provisions:

- In siting the RCEC at its new location, nothing will be done which impairs the operation of the wastewater treatment plant.

- Each party will indemnify the other from responsibility for remediating toxic or hazardous material from the property to be conveyed, consistent with the standard applicable to reuse of the property in a commercial or industrial capacity. Said differently, each party bears the cost of cleaning up the site it is conveying to the other party.

- The City will provide, on a priority basis, 4.1 million gallons a day (MGD) of secondary treated effluent to the RCEC at no cost. The City is authorized to process as much as 16.5 MGD, so this represents only a small portion of the effluent generated by the plant.

With regard to next steps, it is expected that Calpine will know by next spring if it has been successful in entering into a long term power purchase agreement. Then, an amendment to the existing permit will be processed with the CEC. It is estimated that it will be about a year before a final decision is made on the amendment. Assuming a favorable outcome, construction could commence in the summer of 2007, with the RCEC operational two years later.

The energy crisis has not gone away, although it appears dormant and not in the public eye. Nonetheless, the long term viability of the California economy is dependent on addressing this critical issue. Construction and operation of the RCEC is helpful in this regard. Because of this and because of some of the benefits that will accrue to the Hayward community, staff recommends authorization to execute the agreement (a copy of which is on file with the City Clerk's office) with RCEC-LLC.

Jesús Armas, City Manager

Attachments: Exhibit A
Draft Resolution

DRAFT 5

HAYWARD CITY COUNCIL

RESOLUTION NO.______

Introduced by Council Member __________

RESOLUTION AUTHORIZING THE EXECUTION
A COOPERATION AND OPTION AGREEMENT
WITH THE RUSSELL CITY ENERGY CENTER, LLC

WHEREAS, the City and Russell City Energy Center, LLC ("RCEC") have previously entered into agreements for the development of RCEC in the City of Hayward; and

WHEREAS, the City Council has previously found that the development of a modern, clean source of reliable energy is a benefit to the public health, safety and welfare; and

WHEREAS, changing circumstances have necessitated consideration alternative sites for the location of the energy center; and

WHEREAS, RCEC has proposed to construct the energy center on parcels of land owned by the City in its propriety capacity and currently used in connection with the City's waste water treatment facility ("Treatment Facility Land"); and

WHEREAS, as part of its proposal, RCEC is offering to trade comparable parcels of land to the City in exchange for the Treatment Facility Land; and

WHEREAS, the City Council hereby finds that the land to be exchanged is contiguous to the Treatment Facility Land and has been determined to be of equal or greater value; and

WHEREAS, the Council further finds that the exchange of land will be beneficial to the public good and welfare in that it will enable the City to continue to efficiently operate its sewer treatment facility and also provide a site for the construction of an energy center that will provide much needed clean energy for use by the general public; and

WHEREAS, RCEC's proposals are contained in the Cooperation and Option Agreement ("Agreement") on file in the office of the City Clerk.

NOW THEREFORE, the City Council of the City of Hayward does hereby resolve and express its support for the development and construction of the Russell City Energy Center on the land described in the Agreement.

BE IT FURTHER resolved that the City Manager is hereby authorized and directed to execute the attached Agreement, and negotiate and execute any and all related agreements and documents necessary to carry out the purpose and intent of such Agreement in forms approved by the City Attorney.

IN COUNCIL, HAYWARD, CALIFORNIA______________, 2005

ADOPTED BY THE FOLLOWING VOTE:

AYES: COUNCIL MEMBERS:
MAYOR:

NOES: COUNCIL MEMBERS:

ABSTAIN: COUNCIL MEMBERS:

ABSENT: COUNCIL MEMBERS:

ATTEST:_________________________
City Clerk of the City of Hayward

APPROVED AS TO FORM:

____
City Attorney of the City of Hayward

Attachment DR65-2

Hayward City Council Resolution 05-125

HAYWARD CITY COUNCIL

RESOLUTION NO. 05-125

Introduced by Council Member Jimenez

RESOLUTION AUTHORIZING THE EXECUTION
A COOPERATION AND OPTION AGREEMENT
WITH THE RUSSELL CITY ENERGY CENTER, LLC

WHEREAS, the City and Russell City Energy Center, LLC ("RCEC") have previously entered into agreements for the development of RCEC in the City of Hayward; and

WHEREAS, the City Council has previously found that the development of a modern, clean source of reliable energy is a benefit to the public health, safety and welfare; and

WHEREAS, changing circumstances have necessitated consideration alternative sites for the location of the energy center; and

WHEREAS, RCEC has proposed to construct the energy center on parcels of land owned by the City in its propriety capacity and currently used in connection with the City's waste water treatment facility ("Treatment Facility Land"); and

WHEREAS, as part of its proposal, RCEC is offering to trade comparable parcels of land to the City in exchange for the Treatment Facility Land; and

WHEREAS, the City Council hereby finds that the land to be exchanged is contiguous to the Treatment Facility Land and has been determined to be of equal or greater value; and

WHEREAS, the Council further finds that the exchange of land will be beneficial to the public good and welfare in that it will enable the City to continue to efficiently operate its sewer treatment facility and also provide a site for the construction of an energy center that will provide much needed clean energy for use by the general public; and

WHEREAS, RCEC's proposals are contained in the Cooperation and Option Agreement ("Agreement") on file in the office of the City Clerk.

NOW THEREFORE, the City Council of the City of Hayward does hereby resolve and express its support for the development and construction of the Russell City Energy Center on the land described in the Agreement.

BE IT FURTHER resolved that the City Manager is hereby authorized and directed to execute the attached Agreement, and negotiate and execute any and all related agreements and documents necessary to carry out the purpose and intent of such Agreement in forms approved by the City Attorney.

IN COUNCIL, HAYWARD, CALIFORNIA October 11, 2005

ADOPTED BY THE FOLLOWING VOTE:

AYES: COUNCIL MEMBERS: Jimenez, Quirk, Halliday, Ward, Dowling, Henson
MAYOR: Cooper

NOES: COUNCIL MEMBERS: None

ABSTAIN: COUNCIL MEMBERS: None

ABSENT: COUNCIL MEMBERS: None

ATTEST: Angelina Reyes
City Clerk of the City of Hayward

APPROVED AS TO FORM:

City Attorney of the City of Hayward

Traffic and Transportation

Data Request Responses 66-72

Traffic and Transportation (66-72)

Thermal plumes

66. *Please provide a detailed plume analysis for the thermal plumes generated by the RCEC's exhaust stacks and cooling tower, including:*
    a. *Frequency of plume generation, velocity, shape, continuity, and dispersal, up to and including 2000 feet agl.*
    b. *Meteorological impacts on plume formation and behavior. Please provide the name/type of computer model used and its inputs and outputs.*
    c. *Potential impacts to air mass stability and aircraft operations in the area affected by the plumes. Please consider elements such as aircraft type, speed, and altitude; low visibility; cool temperatures; and calm winds when evaluating potential aviation impacts.*

Response: As stated previously in this document in the response to Data Request #55, the FAA's (2006) safety risk analysis of industrial exhaust plumes in relation to civil aviation (see Attachment DR55-1 in response to Data Request #55, above) has found that the risk of an aviation accident resulting from an industrial exhaust plume is extremely low. The FAA study concluded that "the risk associated with plumes is deemed acceptable without restriction, limitation, or further mitigation (FAA 2006, Abstract)." In addition, there are currently no procedures by which project proponents are required to notify the FAA regarding the locations or characteristics of exhaust plumes that their projects would be likely to generate. The FAA study has concluded that, as part of the "continuance of training and awareness programs that have been successful with similar hazards of acceptable risk levels" the instructions for notifying the FAA regarding potential hazards to air navigation be modified to include descriptions of thermal plumes from power plants and other industrial sources. However, the FAA has not acted on this recommendation and may or may not do so. The RCEC, furthermore, is not located within the Traffic Pattern Zone of Hayward Executive Airport and is not located along or near any of the established flight paths to or from the airport (see additional discussion in response to Data Request 55, above and Figure DR55-1 and DR55-2).

Notwithstanding this demonstrated lack of hazard to air navigation with regard to industrial exhaust plumes and the lack of a regulatory law, ordinance, regulation, or standard requiring the disclosure, much less the analysis, of industrial exhaust plumes and their characteristics in relation to aviation, the Applicant has conducted a modeling study and detailed analysis of the exhaust plumes that the RCEC's cooling towers and HRSG stacks would be likely to generate. This modeling study follows a methodology (called the Spillane Method) for describing industrial plumes that was developed in Australia (Best et al. 2003). This is the only published thermal plume analysis methodology of its type and applicable to aviation safety analysis known to the Applicant.

The Applicant has also examined the Commission's own documents relating to the Blythe Energy Power Plant (98-AFC-8C) compliance case and the Blythe Energy Project Phase II (02-AFC-01). In the Blythe compliance case, the power plant's cooling tower was in alignment with the Blythe Airport runway centerline approximately one mile from the runway and airplanes would pass directly over the Blythe power plant at an elevation of approximately 300-500 feet above the ground or less when landing (Blythe Energy Project Phase II Commission Decision, page 176). In the Blythe Phase II case, small aircraft also making an approach to the runway would, similarly, pass directly over the Blythe II cooling tower at low altitude before making a right-angle turn to land. The Commission Staff used a methodology for modeling thermal plumes based on the Australian (Spillane) method in assessing the Blythe plumes.

In the Blythe II siting case, the Staff also invoked a standard of 4.3 meters per second (m/s) at 110 meters in height as a benchmark velocity/altitude for initial screening of plume velocities in calm conditions. This is the standard used by the Australian Civil Aviation Safety Authority as a screening threshold (CASA 2004). Industrial sources located near airports in Australia above this standard then conduct additional modeling using meteorological (wind) conditions to determine whether or not a plume of this velocity would occur a significant percentage of the time at this height. Windy conditions will bend thermal plumes to lower maximum elevations and cause more rapid mixing with ambient air than would take place under calm conditions. Unfortunately, the Australian government documents do not present any data or cite any studies in support of this standard.

The FAA industrial plumes safety study (FAA 2006) cited above acknowledges the Australian standard of AC 139-05 (the Australian Government's Advisory Circular), but neither supports this standard for American airspace nor refutes it, saying

> The FAA does not necessarily approve/disapprove or warrant the data contained in the CASA AC 139-05.... However, many narrative sections of AC 139-05 do not apply as Australian laws and regulations regarding land use, hazard assessments, and procedures regarding objects affecting the navigable airspace are far different from those of the United States (FAA 2006: page 6).

Although the Australian standard of 4.3 m/s (9.6 miles per hour) has not been accepted for use in the United States by the FAA and although there is no available documentation to support it, it is the only available standard of reference and Staff has cited it in the Blythe case. The Applicant's analysis is therefore aimed at determining the height at which, during calm conditions, thermal exhaust from either the cooling tower or HRSG stacks would decline to a level below this velocity. If the plume velocities are below this level at an elevation at which airplanes normally operate in the vicinity of the RCEC, then it is clear that the plume velocities will be much lower or will not reach an equivalent elevation when winds or breezes are blowing, which frequently occurs at the project site.

FAA safety regulations generally require aircraft to operate at or above 1,000 feet in elevation in urban or congested areas and above 500 feet in rural areas. In the vicinity of Hayward Executive Airport, the Pattern Altitude (the altitude at which aircraft are required to fly when circling the runway for landing approach) is 600 feet, somewhat lower than the FAA urban standard. This may partly be due to the fact that, in their approach to Oakland International Airport, aircraft fly over the Hayward Airport area. Although the Traffic Pattern Zone extends only one mile from the runway of Hayward Executive Airport and thus aircraft flying within this zone would not fly over the RCEC, as it is 1.6 miles from the airport, it is reasonable to assume that most aircraft flying in the project vicinity would be required to fly at or above 600 feet in elevation.

As will be discussed further, plume heights and vertical velocities were shown in the Australian study (Best et al. 2003) to be significantly less under light wind speeds than the calm conditions assessed here. The procedures presented in the Best paper and used here are based on analytical solutions to the Spillane methodology for calm conditions.

For this analysis, three different stack conditions were assessed for the RCEC using the Spillane methodology: plumes from a single cooling tower cell, merging of plumes from the nine cooling tower cells, and plumes from a single turbine/HRSG. The Spillane methodology is based on the following procedure based on calm conditions:

1. Determine the height and vertical velocity of the initial momentum-dominated plume rise phase (jet phase).
2. Calculate virtual source height parameters to approximate the jet phase results for use in subsequent calculations of the buoyancy-dominated plume rise phase.
3. Determine the plume top-hat diameters as a function of plume height (a linear relationship under calm conditions) for various heights and then determine plume-averaged vertical velocities at this height assuming conservation of momentum.
4. For multiple plumes (used for cooling tower cells), determine the beginning and ending heights in the transition from single plumes to merged plumes and then calculate the resulting plume parameters including plume top-hat diameters and plume-averaged vertical velocities. These parameters are increased by factors of $N^{0.25}$ under merged plume conditions (where N equals the number of merged plumes).

RCEC stack characteristics are shown in the following table:

TABLE DR66-1
RCEC Stack Characteristics

Stack Parameter	Cooling Tower Cells (Each cell)	Turbine/HRSG Stack
Stack Height h_s (meters)	18.288	44.196
Stack Diameter D (meters)	9.754	5.4864
Stack Velocity V_{exit} (m/sec)	10.308	21.655
Volumetric Flowrate (m^3/sec)	770	512
Stack Potential Temp θ_s (Kelvins)	300.27	356.83
Buoyancy Flux F_o (m^4/s^3)	58	286
Number of Cells N	9	N/A
Stack Separation d (meters)	18.325	N/A

Notes:

Buoyancy flux calculated for ambient temperature θ_a of 293 Kelvins based on $F_o = gV_{exit}D^2(1-\theta_a/\theta_s)/4$ and assuming neutral conditions ($d\theta_a/dz=0$).

As noted above, initial plume rise is dominated by momentum. At a height of 6.25 diameters (D) above the stack release height, the plume diameter is expected to be approximately twice the original stack diameter, with a gaussian distribution of vertical velocities across the plume diameter (plume center vertical velocity of V_{exit} and plume edge velocity near zero). Based on conservation of momentum, this would give a plume-averaged vertical velocity of $V_{exit}/2$. After the initial jet phase, plume rise is dominated by buoyancy. Under calm conditions, the plume closure conditions can be solved analytically and the plume diameter 2a at a height of z (in meters above the stack release height) under the Spillane methodology is assumed to be equal to $2(0.16)(z-z_v)$ with a virtual source height z_v equal to $6.25D[1-(\theta_e/\theta_s)^{1/2}]$ where θ_e was assumed to be equal to θ_a. Solving these equations gives plume diameters as shown in the table below. Again, assuming a gaussian distribution of vertical velocities from the plume center to the plume edge gives plume-averaged vertical velocities V_{plume} (in m/s) equal to $V_{exit}D/2a$. The height above the stack release height where the plume-averaged vertical velocity equals the Australian CASA critical velocity of 4.3 m/s can also be solved and is included in the table below. All of these calculations are based on the conservative assumption of calm conditions.

The Australian study shows that, in the case of N multiple, equally-spaced identical sources (used for the nine plume cooling tower cells), the plume diameters and plume-averaged vertical velocities under merged conditions increase by a factor of $N^{0.25}$, as stated above. Plume merging begins at a height where the plume diameter for a single cooling tower cell equals the stack separation and is complete (for a perpendicular flow) at a height where the plume diameter for a single cooling tower cell equals twice the plume separation. These heights are included in the table below.

TABLE DR66-2
RCEC Plume Modeling Results using Spillane Methodology for Calm Conditions

Plume Characteristic	Single Cooling Tower Cell	Merged Cooling Tower Cells	Turbine/HRSG Stack
Top of Jet Phase (meters above stack release):	60.96	Same as single cell	34.29
Plume Diameter (meters)	19.507		10.973
Vertical Velocity (m/s)	5.154		10.828
Merged Plume Transition (meters above stack release height)	N/A		N/A
Beginning of Merging		58.01	
Total Merging		115.27	
Virtual Height (meters above stack release)	0.742	Same as single cell	3.218
Plume-averaged vertical velocity (m/s) at 600 feet above ground	1.92	3.32	2.74
Plume-averaged vertical velocity (m/s) at 2,000 feet above ground	0.53	0.92	0.66
Height (feet above ground) where plume-averaged vertical velocities=4.3 m/s	302	478	439

Plume-averaged vertical velocities at 600 feet above ground level are greatest for the merged cooling tower cell plumes, equal to 3.32 m/s. Similarly, the height above which plume-averaged vertical velocities are less than 4.3 m/s is greatest for the merged cooling tower cell plumes and equal to 477 feet above ground level. Therefore, even assuming calm conditions which allow for maximum plume rise/velocity and using the Australian standard of 4.3 m/s as a screening criterion, it is clear that industrial exhaust plumes from the RCEC would not reach the screening level velocity at the elevation normally used by aircraft in this area of 600 feet above the ground surface. RCEC operations will therefore not pose a significant hazard to aircraft operations in the project vicinity. If light aircraft were to experience any effect at all from the RCEC's thermal exhaust plume, the effect would be similar to minor air turbulence that aircraft routinely experience from naturally occurring thermal updrafts and winds and which all pilots are trained to expect.

The calculations presented here are based on worst-case atmospheric conditions of calm conditions. The Best, et al. (2003) technical paper shows that for typical stack characteristics examined, uniform light wind speeds of 1.5 m/s and 3.0 m/s result in decreases in plume-averaged vertical velocities at a height of 200 meters from 7.8 m/s under calm conditions to 5.5 and 3.6 m/s, respectively. Therefore, the use of calm conditions is a conservative approach for plumes from RCEC operations. The RCEC site is located at the bay shore margin and experiences frequent breezes.

Although this analysis has established that exhaust plumes from the RCEC would not cause a hazard to air navigation, it is also important to point out that, not only are aircraft enjoined by FAA safety regulations not to fly at low altitude in urban areas, but also that FAA Notice to Airman FDC 4/0811, dated October 8, 2004, addresses the FAA's security concerns about low-flying craft in the vicinity of critical infrastructure:

> In the interest of national security and to the extent practicable, pilots are strongly advised to avoid the airspace above, or in proximity to such sites as power plants (nuclear, hydro-electric, or coal), dams, refineries, industrial complexes, military facilities and other similar facilities. Pilots should not circle as to loitering in the vicinity over these types of facilities (http://tfr.faa.gov/save_pages/detail_4_0811.html).

Although thermal plumes from stacks and the plume-abated cooling tower are not visible, the plant itself would easily be seen by aircraft and pilots who would know to avoid flying over a facility such as the RCEC that is not located on any standard flight path.

References Cited:

Best, P. et al. 2003. Aviation Safety and Buoyant Plumes. Presented at the Clean Air Conference, Newcastle, New South Wales, Australia. By Peter Best, Lena Jackson, Mark Kanowski of Katestone Environmental, Toowong, Queensland, Australia and Kevin Spillane of Bendigo, Victoria, Austrialia.

CASA (Civil Aviation Safety Authority of Australia). 2004. Guidelines for Conducting Plume Rise Assessments. Advisory Circular AC 139-05(0). Australian Government.

FAA. 2006. *Safety Risk Analysis of Aircraft Overflight of Industrial Exhaust Plumes.* Federal Aviation Administration Safety Study Report DOT-FAA-AFS-420-06-1. FAA Flight Standards Branch, Oklahoma City, Oklahoma. By Gary L. Powell, Alan B. Jones, Mark A. Reisweber, Lt. Col. Paul McCarver USAF, Dr. James H. Yates, and John Holman.

FAA Form 7460-1 filing

67. *Complete and electronically file FAA Form 7460-1 (Notice of Proposed Construction or Alteration). Prior to filing, please submit a copy of the draft project description section of Form 7460-1 to Energy Commission staff for review and comments. The project description should thoroughly explain the nature of the exhaust plume discharge, including the analysis generated in response to Data Request #66.*

Response: The Applicant filed FAA Form 7460-1 electronically with the FAA on March 6, 2007 (see attachment DR67-1). The form as filed did not contain a description of the exhaust plume discharge. In discussions prior to filing with the FAA office in Hawthorne, California that reviews all Form 7460-1s submitted in California, it was determined that the form involves review of solid structures only, and is not for documenting exhaust discharges (personal communication of Sarah Madams, CH2M HILL with Karen McDonald, Federal Aviation Administration, February 23, 2007). This is also clearly stated in the FAA's safety risk study of industrial exhaust plumes (FAA 2006). The RCEC project has the FAA project name RUSSE-000061288-07, and the form documents are known as 2007-AWP-1246-OE and 2007-AWP-1245-OE.

References Cited

FAA. 2006. *Safety Risk Analysis of Aircraft Overflight of Industrial Exhaust Plumes*. Federal Aviation Administration Safety Study Report DOT-FAA-AFS-420-06-1. FAA Flight Standards Branch, Oklahoma City, Oklahoma. By Gary L. Powell, Alan B. Jones, Mark A. Reisweber, Lt. Col. Paul McCarver USAF, Dr. James H. Yates, and John Holman.

FAA Form 7460-1 copy

68. *Upon filing, please provide a copy of the final FAA Form 7460-1 to Energy Commission staff and the Alameda Airport Land Use Commission.*

Response: Attachment DR67-1 is a copy of the FAA Form 7460-1 as it appears on the FAA internet site (one page per stack structure).

Salt cake truck trips

69. *Please provide an estimate of the number of truck trips per year to transport the 4,000 tn/yr of salt cake to the WPCF and the landfill(s) located in Alameda County.*

Response: RCEC will generate approximately 400 truckloads of salt cake per year, or an average of 1.1 trucks per day. This estimate assumes 10 tons of salt cake per load and the previously cited maximum of 4,000 tons/year of salt cake.

Salt cake truck route

70. *Please identify the route(s) the trucks would take to the WPCF and landfill(s) and those intersections along the truck route that are part of the SR-92 and I-880 intersection reconstruction.*

Response: Trucks carrying hazardous materials would travel east on Depot Road from the RCEC, turn south on Industrial Boulevard, and then connect to SR-92, traveling either east or west, depending on the final delivery point for the waste. Since the actual constituents of the salt cake waste stream have not been determined, it is unknown what the final destination of the salt cake will be, so the exact route is unknown at this time. As identified in Amendment Table 3.13-8 and Section 3.13.1.3.2, there are two available non-hazardous landfills, and two available hazardous waste landfills to which the salt cake might be delivered.

Trucks containing hazardous materials traveling to the RCEC would arrive from SR-92, exit Industrial Boulevard heading north, and turn west on Depot Road, arriving at the RCEC just west of Cabot Road.

Traffic analysis

71. *Please include these anticipated truck trips into the traffic analysis that is being revised due to staff's previous data request regarding cumulative traffic impacts (Data Request #53).*

Response: One trip per day added to the existing peak hour traffic volume of 771 on Depot Road between Clawiter Road and Viking Road (peak RCEC plus Eastshore staffing) is an increase of 0.13 percent. One trip per day added to the existing peak hour traffic volume of 1,411 on Industrial Boulevard between Depot Road and SR-92WB (peak RCEC plus Eastshore staffing), is an increase of 0.08 percent. The addition of one truck trip per day on Depot Road (Peak LOS A) and Industrial Blvd (Peak LOS A) would therefore not change the peak LOS classification for either segment of the hazardous waste/material routes. In addition, hazardous waste pickups and hazardous material deliveries will predominantly occur during off-peak hours.

Sludge conveyance

72. *Please provide additional clarification on the method of conveyance of the wastewater sludge from the RCEC to the WPCF.*

    a) *If conveyed via a pipeline, please provide a description of the pipeline and a delineation of its route from the RCEC to the WPCF, and discuss any traffic mitigation that would be required during the installation process.*

    b) *If via truck, please identify the number of truck trips and the route the trucks will take to the WPCF, and add this information to the revised traffic analysis pursuant to staffs' previous data requests.*

Response: Wastewater sludge would be discharged directly to the sanitary sewer and would not be trucked off-site. If the City would prefer that RCEC construct a pipeline to return the sludge directly to the WPCF, then this project change would be handled at a future date in a license amendment.

Attachment DR67-1

FAA Forms 7460-1

Notice of Proposed Construction or Alteration (7460-1)

Project Name: RUSSE-000061288-07 **Sponsor:** Russell City Energy Center

Details for Case : RCEC HRSG Exhaust Stacks

Show Project Summary

Case Status

ASN:	2007-AWP-1245-OE
Status:	Work In Progress
Date Accepted:	03/07/2007
Date Determined:	
Letters:	None

Construction / Alteration Information

Notice Of:	Construction
Duration:	Permanent
if Temporary **:**	Months: Days:
Work Schedule - Start:	04/01/2008
Work Schedule - End:	04/01/2010
State Filing:	

Structure Summary

Structure Name:	RCEC HRSG Exhaust Stacks
Structure Type:	Stack
Other **:**	
FCC Number:	
Prior ASN:	

Structure Details

Latitude:	37° 38' 2.41" N
Longitude:	122° 8' 0.52" W
Horizontal Datum:	NAD83
Site Elevation (SE):	10 (nearest foot)
Structure Height (AGL):	145 (nearest foot)
Marking/Lighting:	None
Other **:**	
Nearest City:	Hayward
Nearest State:	California
Traverseway:	No Traverseway
Description of Location:	Site is located in Hayward, California, approximately 1300 feet southwest of the intersection of Cabot Road and Depot Road. Two exhaust stacks are located adjacent to one another.
Description of Proposal:	RCEC is a 600-MW power plant, proposed to be constructed 1300 feet southwest of the corner of Cabot Road and Depot Road in the City of Hayward in Alameda County.

Common Frequency Bands

Low Freq	High Freq	Freq Unit	ERP	ERP Unit

Specific Frequencies

Notice of Proposed Construction or Alteration (7460-1)

Project Name: RUSSE-000061288-07 **Sponsor:** Russell City Energy Center

Details for Case : RCEC HRSG Exhaust Stacks

Show Project Summary

Case Status

ASN:	2007-AWP-1246-OE	**Date Accepted:**	03/07/2007
Status:	Work In Progress	**Date Determined:**	
		Letters:	None

Construction / Alteration Information

Notice Of:	Construction
Duration:	Permanent
***if Temporary* :**	Months: Days:
Work Schedule - Start:	04/01/2008
Work Schedule - End:	04/01/2010
State Filing:	

Structure Summary

Structure Name:	RCEC HRSG Exhaust Stacks
Structure Type:	Stack
***Other* :**	
FCC Number:	
Prior ASN:	

Structure Details

Latitude:	37° 38' 2.39" N
Longitude:	122° 8' 2.01" W
Horizontal Datum:	NAD83
Site Elevation (SE):	10 (nearest foot)
Structure Height (AGL):	145 (nearest foot)
Marking/Lighting:	None
***Other* :**	
Nearest City:	Hayward
Nearest State:	California
Traverseway:	No Traverseway
Description of Location:	Site is located in Hayward, California, approximately 1300 feet southwest of the intersection of Cabot Road and Depot Road. Two exhaust stacks are located adjacent to one another.
Description of Proposal:	The Russell City Energy Center is a 600-megawatt (MW) power plant, proposed to be constructed 1300 feet southwest of the corner of Cabot Road and Depot Road in the City of Hayward in Alameda County.

Common Frequency Bands

Low Freq	High Freq	Freq Unit	ERP	ERP Unit

Specific Frequencies